SCREWWORM MYIASIS

(Gusanos, Mosca Verde, Gusano barrendor, Gusaneras)

- Definition
- Etiology
- Host Range
- Geographic Distribution
- Life Cycle
- Transmission
- Clinical Signs
- Gross Lesions
- Morbidity and Mortality
- Diagnosis
- Field Diagnosis
- Specimens for the Laboratory
- Differential Diagnosis
- Treatment
- Vaccination
- Control and Eradication
- Public Health
- References
- FAD Table of Contents

Definition top

Myiasis is the infestation of live vertebrate animals with dipterous larvae, which for at least a certain period feed on the host's dead or living tissue, liquid body substances, or ingested food (27). Depending on their reliance on the host, such larvae are classified as obligatory or facultative. Screwworms are classified as obligatory because they feed on live tissue. Screwworm larvae penetrate deeply into a wound of a warmblooded animal and feed on living tissue and body fluid. Facultative larvae, which feed on dead tissue and decaying matter, may be present in wounds — even simultaneously with screwworm larvae.

Etiology top

Screwworm myiasis is caused by two species of diptera larvae in the family Calliphoridae, subfamily Chrysomyinae: *Chrysomya bezziana* (Villeneuve), Old World Screwworm, and *Cochliomyia hominivorax* (Coquerel), New World

Screwworm (15).

Host Range top

Any warmblooded animal, including human, is subject to screwworm myiasis, but infestation in poultry or fowl is rare.

Geographic Distribution top

Screwworms survive from year to year in tropical and semitropical regions. The insect is killed by freezing temperatures or long periods of near-freezing temperatures. Because of susceptibility to low temperatures, occurrence of screwworms may be seasonal, and rarely are they found more than 7,000 feet above sea level.

New World Screwworm was first reported in the southeastern part of the United States in 1933 and probably had been introduced through the importation of animals with screwworm myiasis from the southwestern United States (3). New World Screwworm survived winters in the United States in Florida and Texas and occasionally in southern Arizona and California. During the spring and summer, screwworms spread north to the central United States, creating a seasonal problem for livestock and wildlife.

Eradication of the New World Screwworm from the southeastern United States was initiated in early 1959. This effort was aided by a colder than normal winter that limited survival of the insect to the southern half of the Florida peninsula. Near the end of 1961, the southeastern United States was declared free of this pest. Then, in early 1962, a similar eradication program was initiated in the southwestern United States. Again the program was aided by a colder than normal winter that limited survival of the insect to the southernmost part of Texas. Near the end of 1964, the screwworm was declared eradicated from all of the contiguous states of the United States. From 1965 to 1981, a buffer zone was maintained, with varying degrees of success, along the entire expanse of the United States-Mexican border region. The objective of the buffer zone was to control the migration of the screwworm from Mexico into the Untied States and to minimize the incidence of cases of screwworm in the region.

In August 1972, an agreement between the United States and Mexico was signed establishing a joint commission to eradicate screwworm from Mexico. Such an action was considered necessary to prevent screwworm infestation in the United States totally. Eradication of the screwworm from Mexico was initiated near the end of 1976, and progressed from north to south (17). The last local case of

screwworm in the United States was reported from Star County, Texas, in August 1982. Mexico and the United States signed agreements with Guatemala in 1986, and Belize in 1988, to extend the joint eradication program into those countries. Mexico was declared free of the screwworm in February 1991.

Cattle movements from Central America north into Mexico continued to present a threat of reinfestation. Such activity was probably responsible for outbreaks discovered in central and southern Mexico in 1992 and 1993. These outbreaks were rapidly contained and eliminated.

The United States signed agreements with Honduras, El Salvador, and Nicaragua in 1991, with Costa Rica in 1993; and with Panama in 1994. To maintain the North American continent free of the screwworm, it was considered necessary to extend the eradication program to Central America and Panama. A permanent barrier will be established at the Isthmus of Panama to prevent reinfestation of regions to the north.

Guatemala and Belize were declared free of the screwworm in 1993. Then El Salvador and Honduras were declared free of the pest in 1995 and 1996, respectively. The last local case of screwworm in Nicaragua was reported in February 1997. Eradication of the screwworm was initiated in Costa Rica in early 1996 and is scheduled to be initiated in Panama in 1998.

Other regions of the Western Hemisphere that have been freed of the New World Screwworm are Puerto Rico, the Virgin Islands, and the island of Curacao of the Netherlands Antilles. New World Screwworm is present on several of the islands in the Caribbean Sea and in the tropical and semitropical regions of South America. There is a seasonal spread of the screwworm into the temperate regions of Argentina, Uruguay, and Paraguay in the spring and summer (12). Rarely is screwworm reported in Chile or southern Argentinia, and then only from imported animals.

The only recorded establishment of New World Screwworm in the Eastern Hemisphere was in a 20,000-square kilometer area around Tripoli, Libya, in north Africa. Introduction of the screwworms is thought to have occurred with animals imported from South America during or before 1988. The outbreak was eradicated in 1991.

Old World Screwworm has never become established in Europe, North Africa, the Middle East, Australia or the Western Hemisphere. It is found in most of the remainder of the tropical and semitropical regions of the Eastern Hemisphere: the Indian subcontinent, Southeast Asia, the main island of Papua New Guinea,

tropical and sub-Saharan Africa , Oman, Muscat, Fujaira, and Kuwait (24).

Life Cycle top

Screwworm larvae feeding in a wound are closely packed. As the larvae feed, they destroy tissue, thus continually making the wound larger. Within 5 to 7 days the larvae reach maturity. At this stage of development (third instar), the larvae will exit the wound and drop to the ground. Mature larvae are negatively phototrophic (i.e., they move away from light and usually burrow 2 to 5 cm deep in the soil, where they develop into pupae. Many larvae do not survive owing to desiccation and predation (2). Transformation into the fly occurs during the pupal stage and may take about 7 days at 28° C (82.4° F) or may take as long as 60 days at temperatures of 10-15° C (13,21).

Flies that survive during this stage of development emerge from the pupal casing, taking about 2 hours to dry, spread their wings and then seek food such as water and nectar. Survival of the flies is dependent on temperatures, humidity, food sources, host availability, and other ecological factors (21). Ambient air temperatures of 25-30° C (77-86° F) with a relative humidity of 30-70 percent are ideal parameters for screwworm fly activity and survival. Adult screwworm flies find superficial wounds on warmblooded animals and feed on fluids in the wound.

After 3-5 days the flies are ready to mate. Male screwworm flies will mate several times. Females usually mate once. About 3-4 days after mating, the female fly seeks a superficial wound on a warmblooded animal to oviposit eggs along the edge of the wound in a shinglelike manner. Larvae up to 2 mm in length emerge from the eggs in 8 to 12 hours, enter the wound, and begin feeding.

Female New World Screwworm flies oviposit up to 400 eggs in a single egg mass and one fly may oviposit 6 to 8 batches of eggs in her life (25). An egg mass from the Old World Screwworm contains about 100 to 250 eggs (15). Male screwworm flies usually survive about 14 days; females often survive 30 days.

Transmission top

The distance that female screwworm flies travel depends on the ecological conditions, food supply, and availability of hosts with suitable wounds. The female flies tend to range only 10-20 km in tropical environments when there is a high density of animals. In arid environments with lower densities of animals, screwworm flies have traveled as far as 300 km (12). Often in more arid areas, screwworm flies will travel along water courses. In mountainous areas, screwworm flies will travel the course of valleys, where the climate is warmer, moisture is

high, and animal density is high. Vehicles, especially those transporting animals, may contribute to dispersing screwworm flies in some areas. Wind may also be a factor.

Transmission of screwworms into nonendemic areas and over long distances is often the result of transporting animals with screwworm myiasis or carrying screwworm adults on transport vehicles. When new infestations are not treated and larvae mature and exit the wounds, there is the potential for screwworms to become established in a new area.

Clinical Signs top

Wounds that may become infested by screwworms include those caused by engorged ticks, bites of vampire bats, castration, dehorning, branding, wire cuts, sore mouth in sheep, shedding of the velvet in deer, and a multitude of other causes. Navels of newborn mammals are a common site for screwworm infestation. Early stages of the larvae feeding in a wound are very difficult to see; only slight movement may be observed. As the larvae feed, the wound is gradually enlarged, becoming wider and deeper. By the third day, as many as 100 to 200 tightly packed, vertically oriented larvae can easily be observed embedded deep in the wound. Screwworm larvae tend to burrow deeper in a wound when disturbed and will generally not be seen crawling on the surface (Fig. 100).

After 5 to 7 days, a wound may be expanded to 3 cm or more in diameter and 5 to 20 cm deep with larvae from a single screwworm egg mass. Usually by this stage, additional screwworm flies have deposited eggs, resulting in a multiple infestation. A serosanguineous discharge often exudes from the infested wounds, and a distinct odor may be detected. In some cases, the openings in the skin may be small with extensive pockets of screwworm larvae beneath. In dogs, screwworm larvae commonly tunnel under the skin. Screwworm infestations in anal, vaginal, and nasal orifices may be difficult to detect, even in the later stages.

Animals with screwworm infestation usually display discomfort, may go off feed, and produce less milk. Typically animals with screwworm myiasis will separate themselves from the rest of the flock or herd and seek dark or shady areas to lie down. Goats frequently hide in caves. Fawns have often been observed standing in streams with water up to the abdomen when they have screwworm myiasis in the navel. Brahman-type cows will often lick the screwworm-infested navel wounds of calves — a process that cleans most larvae from the wound and reduces losses in this breed of cattle. Animals with screwworm myiasis may die in 7 to 14 days if wounds are not treated to kill the larvae — especially in cases of multiple infestation. As many as 3,000 larvae may be found in a single wound (17). Death

probably results from toxicity, a secondary infections, or both. Smaller animals usually die of screwworm myiasis in a shorter time than larger animals. Location of the wound infestation is also a determining factor in the time of death.

Morbidity and Mortality top

In some areas of the Western Hemisphere where screwworm populations are high and climatic and ecological conditions are ideal, livestock owners report that every newborn animal will get a screwworm infestation in the navel wound if it is not treated soon after birth. A study on the King Ranch in south Texas in the United States during the 1950's showed that screwworm seriously affected the deer population. In some years, up to 80 percent of the fawns died due to screwworm whereas in other years the death rate was around 20 percent (9). Mature larvae exiting untreated wounds may contribute to increasing the screwworm fly population in the immediate area, and, as the screwworm population increases, the percentage of animals with superficial wounds that become infested also increases.

Screwworm infestations that are treated and those that result from one oviposition are usually not lethal to the animal; however, death is always a possibility, especially in very small animals. Secondary infection is also common.

Animals with untreated screwworm infestations will often have more than one screwworm fly oviposit at the wound site, or the same fly may oviposit more than once. Left untreated, these multiple infestations often result in death of the animal, within 7 to 10 days, depending on the size and condition of the animal, the location of the infestation, and whether there are other complications such as infection or toxicity. Animal deaths due to the Old World Screwworm appear to be less common than with the New World Screwworm.

Diagnosis top

Field Diagnosis top

Screwworm myiasis should be suspected when the described clinical manifestations are seen. New World screwworm may be observed as creamy white eggs deposited in shinglelike fashion on the border of a superficial wound. Small screwworm larvae up to 2 mm in length hatch from the eggs in 8 to 12 hours. Egg masses of Old World Screwworm are indistinguishable except individual eggs are larger. Eggs in the masses deposited by other species of blow flies are not well organized. *C. macellaria* deposit eggs on the margin or in the hair close to a wound. Microscopic examination is required to distinguish individual eggs of this

species from those of the screwworm. *Sarcophagidae* species. deposit live larvae into a wound or in soiled wool or hair. Larvae of these species are facultative and may be seen in wounds, usually near the surface, feeding on necrotic tissue or organic matter.

Larvae can be removed from a wound with tweezers. Second and third instar screwworm larvae are cylindrical, are pointed at one end and blunt at the other, and have complete rings of dark brown spines circling the body. The shape and characteristics of the second or third instar larvae (Fig. 101) resemble a wood screw, thus giving rise to the common name of the pest. Field diagnosis is difficult — even for trained individuals. A magnifying glass or microscope is usually necessary to see the distinguishing characteristics of the various insect stages. A diagnosis in the field should always be considered presumptive.

Female screwworm flies may be observed visiting a wound. They are about two and a half times the size of the common house fly. New World screwworm flies have a darkblue to blue-green thorax with a reddish-orange head and have three longitudinal dark stripes on the back of the thorax with an incomplete center stripe (Fig. 102). Old World Screwworm flies have bodies that are green to bluish-black and have two transverse stripes on the thorax. *C. macellaria* flies are similar but have a green thorax with three complete dorsal stripes.

Specimens for the Laboratory top

Before treatment, a sample of larvae should be removed from the wound using tweezers for submission to the laboratory. Eggs should be carefully removed from the edge of the wound using a scalpel. For laboratory diagnosis, specimens of eggs, larvae, or flies should be placed in 70 percent alcohol and sent to a recognized diagnostic laboratory (do not use formalin as a preservative). Because screwworm larvae penetrate deep into a wound, and other facultative larvae may exist more superficially in the same wound, specimens of larvae for laboratory diagnosis should be collected from the deepest part of the wound. In the United States, send specimens to the National Veterinary Services Laboratories, P.O. Box 844, Ames, IA, 50010. Experienced professional personnel will identify the specimens.

Differential Diagnosis top

Scewworm larvae must be differentiated from larvae of other species of blow flies that may be present in a wound on any warmblooded animal.

Treatment top

Before treatment, a sample of the larvae should be removed from the wound for submission to a laboratory using tweezers. Screwworm myiasis is treated with topical application of an approved larvacide directly into the infested wound. Wounds should be retreated two to three times on successive days to ensure that all of the larvae have been killed and removed. With this treatment, the wound will heal rapidly and will not become reinfested with screwworm larvae

Vaccination top

There is no vaccine.

Control and Eradication top

Prevention

Where screwworm is endemic, animals must be inspected at least every 3 to 4 days to discover and treat cases of screwworm myiasis. Open wounds on animals not infested with screwworm larvae should be treated to prevent infestation. In areas where screwworm myiasis is a seasonal occurrence, animal breeding can be regulated so births occur during the season when screwworm myiasis is rarely encountered. Similarly, management practices that create wounds, such as branding, castrating, dehorning, docking, or other operations, can be programmed for the season when screwworm myiasis is rare.

Treating wounds and spraying or dipping animals with an approved organophosphate insecticide will provide protection against screwworm infestation for 7 to 10 days. Should a screwworm egg mass be deposited on the edge of a wound on an animal treated with this insecticide, the newly hatched larvae will encounter the residual insecticide as they crawl into the wound and will be killed. This usually gives wounds sufficient time to heal. If wounds are already infested with screwworm second-or-third instar larvae when an animal is sprayed or dipped with the organophosphate insecticide, the treatment usually does not kill all larvae present. Therefore, this form of treatment should be used only as a preventive measure and not as a cure.

Preventing the introduction of screwworm into areas that have the ecological environment for screwworm propagation but are currently without the pest is an important aspect of control. Blocking such introductions is accomplished through voluntary and regulatory actions. Immediately before being transported from where screwworm is endemic, animals, this includes pets, should be thoroughly inspected for the presence of a superficial wound subject to screwworm

infestation. All wounds should be treated with an approved organophosphate insecticide followed by a precautionary spraying or dipping of the animals before they are moved. An animal having wounds suspected of being infected with screwworm should not be moved until the wounds have been properly treated and have healed.

Conveyances should be sprayed with insecticide to kill any adult or immature screwworm flies. Upon arrival at the destination or port of entry, these animals should again be inspected and undergo treatment of all wounds or suspected screwworm myiasis.

Eradication

Eradication of the screwworm has been successful only when the sterile-male technique has been applied to an area. After the lab-reared insects are in the pupal stage for about 5.5 days, or 24 hours before the adult flies emerge, they are exposed to 5,000 to 7,000 rads of gamma radiation. This exposure to radiation renders the insects sexually sterile without adversely affecting them in any other way (4). Once released, sexually sterile male screwworm flies mate with native females. These females then deposit unfertilized eggs that, of course, do not hatch, thus breaking the life cycle.

Eradication areas are blanketed weekly with an equal proportion of sterile male and sterile female flies at the usual dosage rate of 3,000 per square mile. There is currently no practical method of separating the mass-produced, lab-reared males and females. Although eradication of the screwworm from an area may be enhanced by releasing a higher proportion of sterile males, the benefit of releasing sterile females needs further investigation. Nonetheless, use of the current technology has been successful. The actual dosage of sterile screwworm flies released over an area will vary according to the estimated local screwworm population, host density, and the local ecology The dosage should be sufficient to release 300 sterile male screwworm flies or more for one native male screwworm fly (14). Using this technology together with larvacide treatment of wounds and control of transport of screwworms through animal movements usually results in eradication of the insect from that area in 2 years or less. This dosage of sterile males will usually outnumber the native male screwworm fly population by 300 or more to 1 (16).

Public Health top

Humans are susceptible to screwworm myiasis.

GUIDE TO THE LITERATURE top

1. BAUMHOVER, A.H., GRAHAM, A.J., BITTER, B.A., HOPKINS, D.F., NEW, W.D., DUDLEY, F.H., and BUSHLAND, R.C. 1955. Screwworm control through release of sterilized flies. J. Econ. Entomol., 48:462-466.

2. BAUMHOVER, AH. 1963. Susceptibility of screwworm larvae and prepupae to desiccation. J. Econ. Entomol., 56:645-649.

3. BRUCE, W.G., and SHEELY, W.J. 1944. Screwworm in Florida. Agricultural Extension Service, University of Florida. Bull. No. 123.

4. BUSHLAND, R.C., and HOPKINS, D. E. 1953. Sterilization of screwworm flies with X-rays and Gamma-rays. J. Econ. Entomol., 46:648-656.

5. BUSHLAND, R.C. 1960. Sterility principles for insect control, historical development and recent innovations. I.A.E.A. IAEA-SM138, pp. 3-4.

6. BUSHLAND, R.C. 1985. Eradication Program in the Southwestern United States. In Symposium on Eradication of the Screwworm from the United States and Mexico. Misc. Publ. of the Entomological Society of America, No. 62.

7. COPPEGE, J.R., GOODENOUGH, J.L, BROCE, A.B., TANNAHILL, F.H., SNOW, J. W., CRYSTAL, M.M., and PETERSON, H.D. 1978. Evaluation of the screwworm adult suppression system (SWASS) on the island of Curacao. J. Econ. Entomol., 2:579-584.

8. CUSHING, E.C., and PATTON, W.S. 1933. Cochliomyla americana SP NOV. The screwworm fly of the New World. . Ann. Trop. Med. Parasitol. 27(4):539-551

9. FULLER, G. 1962. How screwworm eradication will affect wildlife: The eradication of the screwworm in the Southwest will result in a larger deer population in the region. The Cattleman. May.

10. GAGNE, R.J. 1981. Chrysomya spp., Old World blow flies (Diptera: Calliphoridae), recently established in the Americas. Ent. Soc. of Amer. Bull., Vol. 27(1):21-22.

11. HALL, M.J.R. 1989. Manual for identification of the screwworm fly, *Cochliomyia hominivorax* (Coquerel), in North Africa. London: British Museum of Natural History.

12. HIGHTOWER, B.G., ADAMS, A.L., and ALLEY, D.A. 1965. Dispersal of released irradiated laboratory-reared screwworm flies. J. Econ. Entomol., 58:373-374.

13. HIGHTOWER, B.G., SPATES, G.E., Jr., and Garcia, J.J. 1971. Emergence rhythms of adult screwworm, J. Econ. Entomol., 64:1474-1477.

14. HORN, Carlos Silvino. 1987. Bovine Ectoparasites and Their Economic Impact in South America. In Proceedings of the MSD AGVET Symposium. XXIII World Veterinary Congress. Montreal, Quebec, Canada.

15. KETTLE, D.S. 1981. Medical and Veterinary Entomology, New York: Wiley-Interscience, pp. 241-261.

16. KNIPLING, E.F. 1960. The eradication of screwworm fly. Sci. Amer., 203:54-61.

17. LINDQUIST, A.W. 1937. Myiasis in wild animals in southwertern Texas. J. Econ. Entomol., 30:735-740.

18. LINDQUIST, D.A., and ABUSOWA, M. 1991. The New World Screwworm in North Africa. (Special Issue of the New Animal Review FAO), pp. 2-7.

19. MEYER, N.L 1987. History of the Mexico-United States screwworm eradication program. APHIS/USDA Contract No. 533294-6-65.

20. NOVY, J. E. 1991. Screwworm Control and Eradication in the Southern United States of America. (Special Issue of World Animal Review FAO), pp.18-27.

21. PARMAN, D.C. 1945. Effect of weather on Cochliomyla americana and a review of methods and economic applications of the study. J. Econ. Ent., 53:1110-1116.

22. SCRUGGS, C.G. 1975. The peaceful atom and the deadly fly. Jenkins Publishing Co., The Pemberton Press.

23. SNOW, J.W., and COPPEGE, J.R. 1978. The screwworm *Cochliomyia hominivorax* (Diptera: *Calliphoridae*) reinfests the island of Curacao, Netherlands Antilles. J. Econ. Entomol., 14:592-593.

24. SPRADBERRY, J.P.; and HUMPHERY, J.D. 1988. The Screwworm Fly: *Chrysomya bezziana*. In Proceedings from the Veterinary Conference, Camden, Australia.

25. THOMAS, D.B., and MANGAN, R.L. 1989. Oviposition and wound visiting behavior of the screwworm fly, *Cochliomyla hominivorax* (Diptera: Calliphoridae). Ann. Entomol. Soc. Amer., 82:526-534.

26. WILLIAMS, D.L., GARTMAN, S.C., and HOURRIGAN, J.L. 1977. Screwworm eradication in Puerto Rico and the Virgin Islands. FAO World, pp. 31-35.

27. ZUMPT, F. 1965. Myiasis in Man and Animals in the Old World. London: Butterworths, pp. 267.

James E. Novy, D.V.M., USDA, APHIS, retired, Tyler, TX
