



**UNIVERSITI PUTRA MALAYSIA**

**A STUDY OF THE INCIDENCE AND ECONOMIC IMPORTANCE  
OF THE SCREW-WORM FLY INFESTATION ON  
BEEF CATTLE (PAHANGBIF SDN.BHD.)**

**SULAIMAN BIN A. KADIR**

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BEEF CATTLE (PAHANGBIF SDN.BHD.)**

by

**SULAIMAN BIN A. KADIR  
DVM 5 (1979/80)**

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## Abstract

The incidence and economic importance of maggot wound infestation was studied at the Pahangbif farm Sdn. Bhd. Segamat; for a period of four weeks. Chrysomia bezziana was found to be the only species involved in 84.4% of 45 larval samples from myiasis cases observed in a 3200 head of beef cattle during the study. Adults flies were trapped within little success. Observations were made on behavior of adult C. bezziana that were bred out from third stage larvae collected from wounds and reared on papaya. Males and females reach sexual maturity at 3 and 6 days respectively; mating commenced at 6 days of age.

Myiasis cases were related to season, calving period as well as treatment and control methods practiced by this farm.

The most favoured site was in the perineal region among adult cattle and the navel for newborn calves.

Attempts were made to quantify some of the economic losses due to screw-worm fly on this farm.

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## 1. Introduction

Screw-worm myiasis, is one of the commonest disease that effects our livestock animals particularly cattle. Any type of wound, if left untreated, is very likely to become maggot infested. All livestock keepers seem to be aware that maggot infestation of wounds is a condition which requires prompt attention.

Reports from various State Veterinary Departments and several other cattle farms mention the high number of maggot wound cases they treat. For example, maggot-wound contributed about 21.7% of the total diseases that occurred in Institute Haiwan Kluang in 1978.

Pahangbif Sdn. Bhd. also reported that at least 30 - 40% and 40 - 45% of their adults cattle and newborn calves respectively are affected by maggot wounds annually since the farm started in 1975.

Little study has been made on it in this country. So the frequency of occurrence and the hazard it presents to the animals in this country is reflected very sparsely in the literature.

The aim of this study was to explore some aspects of myiasis and the hazard it presents to our livestock industry. The practical aspects were carried out at the Pahangbif farm, Segamat.

### 2.. A brief description of Pahangbif farm.

This farm is about 8000 acres, but only 5000 acres have been developed; 500 acres of the developed area are made up of swampy area and secondary jungle. The farm is surrounded by primary jungle and oil palm estates. The farm is divided into 4 units. Total number of animals at present is about 3200 head.

### 3. Literature review

The name screw-worm is given to the larvae of *Callitroga* (*Cochlyomia*) and *Chrysomia* species. *Callitroga americana* (Fabricus) (Syn. *Coch. hominivorax*) (Coquerel) is found in North and South America and is known as "The New-World screw-worm fly". *Chrysomia* species particularly *C. bezziana* (Villeneuve) or "The Old-World screw-worm fly" occupy most of the tropical regions. Although they are different species, they have remarkably similar life-cycles and both lay their eggs on warm-blooded animals (17).

*C. bezziana* is the most important myiasis producing Calliphorid of the South-East Asia region (5). The larvae of *C. bezziana* were recovered from two cases of navel strike in *Bos indicus* calves less than one week old in Kampung Pandan, Kuala Lumpur (17). *C. bezziana* infestation is often seen in the Tekam Research Station, Jerantut (10). Cattle are not the sole host of *C. bezziana* in this country, camels, hogs, deer and wallabies at the Malayan National Zoo, Kuala Lumpur being reported infested by this fly larvae (3). Human infestation has been reported in other countries, in India (15, 16) and in the Congo (21). Various species of *Chrysomia* were involved in causing myiasis in the New-Guinea and New Britain, 89% being caused by *C. bezziana* (12).

Cases of *C. bezziana* maggot strike have also been reported in Indonesia, in Indo-China and in Formosa (21).

*C. bezziana* is as a serious pest of cattle in Rhodesia (18). "Next to the Fsetse-fly (*Glossina morsitans* West), *C. bezziana* is the most important insect pest of cattle, horse, dogs and other domestic animals in Rhodesia (21).

*C. bezziana*, to some extent at least, is forest-loving and therefore probably a shade-loving insect (12). The female flies were frequently observed feeding upon the blood and septic liquids exuding from wounds of cattle, but not

on purulent wounds (6). Adult males are rarely attracted even to animals with open wounds (9). In New Guinea most cases of fly strike are initiated between 4 p.m. and dusk. It seems the pest has evolved under considerable selection pressure for late afternoon egg-laying (9).

Adults C. bezziana are able to fly 25 km. (9). They do not readily venture in flight over habitats devoid of favoured hosts, and may differ from Coch-hominivorax in this respect. It is less likely to venture over open stretches of water (12).

Both C. bezziana and Coch. hominivorax appear to have no life-cycle stages particularly well adapted to resist cold. In New Guinea screw-worm attacks have been recorded up to 5000 feet, where the mean temperature would be about 64 F, but it is not known whether this indicates permanent occupation of the area or temporary invasions from the lower regions (2).

Almost 200 factors are known to effect Coch. hominivorax fly populations (14). In the Tekam Research Station, Jerantut, the high incidence of strike is between July and November (10).

Fatality due to C. bezziana is not uncommon. If navel myiasis in calves is left untreated, they may die within 4 days (12). Mortality due to myiasis also has been noted to occur among cattle and buffalo in Cambodia (20).

An animal recovering from strike seems to develop a slight immunity, particularly around the wound; although it can be struck again. Antibodies developed by such cattle have been isolated (19).

The screw-worm fly Coch. hominivorax is a vector of joint ill in calves in Florida on epidemiological evidence (7).

The larvae of Coch. hominivorax were causing annual losses to the United States livestock industry of 10 million dollars; 20 years later Florida alone reported losses of this size, whilst in the South-Eastern States the

loses had risen to more than 20 million dollars per annum and in the South-Western States, the estimated losses were 100 - 200 million dollars annually (19).

#### 4. Materials and methods

Daily inspection were made on the animals and around the farm throughout the study period (4 weeks). Maggot samples were collected from strike cases that I was able to attend personally. Half of the maggots from each case were preserved in 70% alcohol mixed with 5% glycerol and the remainder were cultured. Traps and insect nets were also used to catch adult flies. Traps were hung on the trees in the area where the animals usually gather. Bovine liver and chemical solutions consisting of benzoic acid, acetic acid, methanol, ethanol, isobutyl alcohol, formalin and acetone were used as baits. These chemical solutions were used either separately or in combination accordingly to the formulae of Calvin et al. (1976). Bait were changed every third day.

Cases of strike on animals were recorded with reference to and site of the lesion.

Data on the numbers of animals affected, total treatments, calving records and rainfall, which were kept by this farm were examined and analysed.

#### 5. Results

##### 5.a. Traps, nets and culture

Both liver and chemical baits attracted very small number of flies. Only species like C. megacephala, C. rufifacies and Sarcophaga species were attracted to liver bait and Sarcophaga and Musca species to chemical baits.

The incidence of the species causing myiasis in this farm based on maggots preserved and flies that were bred out from maggots were as follows:

<u>Species</u>	No. of case
<u>C. bezziana</u> alone	38
<u>C. bezziana</u> + ( either <u>C. megacephala</u> or <u>C. rufifacies</u> )	6
<u>C. Megacephala</u>	1
Total	45

C. bezziana was therefore involved in 84.4% of the strike cases observed. In the mixed strike it was not known which species was the primary one.

## 5.2 Favoured sites

Table 1: Occurrence of strike at different sites on the cattle

Site	No. Case	Percentage of Total Cases
Perineal	59	43
Body underline	28	20
Body	18	13
Legs, foot	14	10
Head, ear, neck	9	7
Inguinal	6	4
Tail	4	3
Total	138	100

It showed that the perineal region was the most favoured site. The tail and inguinal region were the least.

The usual number of strikes per animal in this study was one, but in some cases it can be multiple. Even with only one wound; in a few cases, one could see layers of larvae either consisting of various stages or all third stage. Sometimes the larvae were arranged in layers two or three deep.

### 5.3 Age of affected animals

Struck wounds were observed more on adults cows but this is expected as they make up the bulk of the cattle population on this farm. Navel strike occurred on calves less than one week old and a high number are experienced during the main calving season. In calves with rectal myiasis usually occurred following diarrhoea.

### 5.4. Breed susceptibility

All the animals on this farm are Drought-Master. Study by Fadzil et (1971) at Sungai Tekam Research Station, Jerantut found that both native and cross-bred cattle were equally vulnerable to attack by C. bezziana. The susceptibility of this breed to screw-worm infestation probably depends on the stability of their genetic combination, the amount of temperature blood they have, characteristic of the skin, their adaptation to tropical situations, condition of the area where they are reared and their attitude. However the most important criterion that determines whether they are to be affected or not will depend on the presence of presence of predisposing factors and also on the standard of management on the particular farm.

### 5.5 Seasonal activity of the flies

Seasonal activity of the flies in this farm was not well understood. From the records that were available, there appears to be a prevalence of strike between June and November which period accounts for about 62.60% of the total number of cases recorded annually. It might be that this period was towards the end of the main calving season, and navel and rectal strike in calves and post-calving vulval strike in cows, which all are considered major problems would be concentrated in this period. The incidence tended to increase during wet days and was less during hot, dry days. The prevalence of strike and total number of treatment at different months of the year and its relation to rainfall are present in table 2 and graph 1 respectively.

Table 2: Occurrence of strike cases and number of treatments at different months of the year 1979

Months	Type of animal		Total	Percentage of Total cases	Total no. of treatment
	Adults	Calves			
January	144	33	177	5.99	890
February	140	72	212	7.18	1060
March	58	134	192	6.51	962
April	96	97	193	6.54	967
May	81	81	162	5.49	809
June	106	100	206	6.98	1030
July	369	135	504	17.08	2522
August	190	169	359	12.17	1670
September	212	110	322	10.91	2245
October	188	18	206	6.98	1001
November	250	-	250	8.48	1216
December	156	12	168	5.69	723
Total	1990	961	2951	100.00	15095

Table 3: Calving record for the year 1979

Month	No.
January	29
February	90
March	213
April	103
May	67
June	70
July	94
August	42
September	17
October	15
November	5
December	5
Total	750

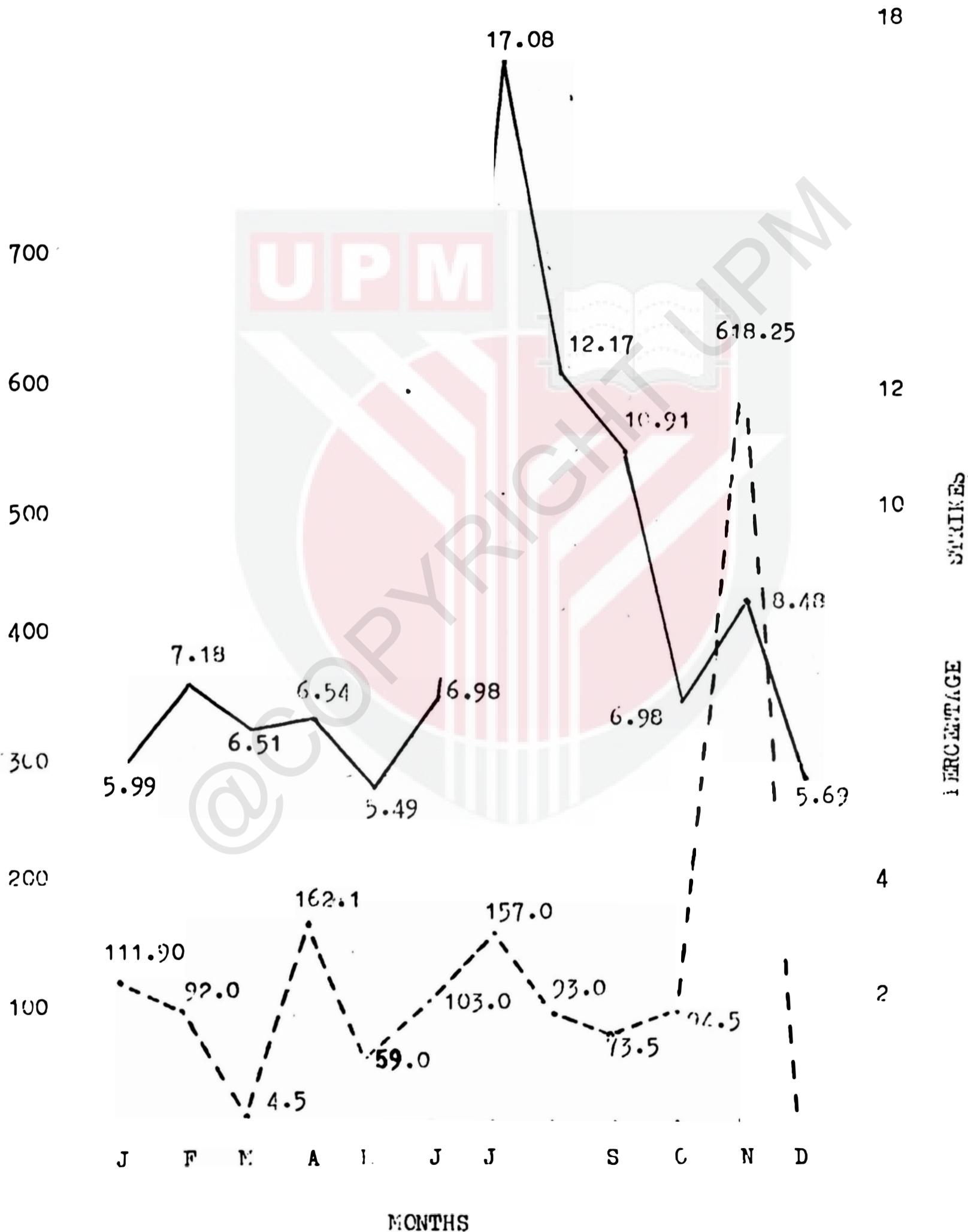
### 5.6 Predisposing factors

There are numerous lesion that will predispose cattle to myiasis. Almost any type of wound on the animal can be struck. On this farm the factors like woodstumps, barbed wire, fighting injuries, improper attention to the navel of newborn calves, careless moving of cattle into or out of yards, all wound creating operation, vulval or anal mucous discharges, diarrhoea and tick bites could lead to myiasis. Wounds on the perineal region, feet and body in majority caused by woodstump.

Graph 1: Relation of rainfall and prevalence of strike at different months of the year 1979

percentage of strike cases

----- rainfall in centimetres



## 6. Biology and ecology

Adult *Chrysomia* were quite often seen on this farm during the study period but only in the yard during treatment. Most of them were seen between 10.00 a.m. to 1.00 p.m. and only one case at 4.30 p.m. only two to three flies being seen at anyone time. The flies were seen flying around, never staying on the animals and occasionally resting on the yard. They are timid and difficult to catch. The adults flies were not seen in other areas.

The cultured larvae bred out approximately equal numbers of both sexes of adults. These flies were reared on papaya. From these reared flies, it found that males reached sexual maturity earlier than females, probably at 3 days of age. Females reach puberty probably at 6 days because matings were seen at this period. At 9 - 10 days female flies were seen rejected sexual attempts by males. So female *C. bezziana* flies appear to have the same short period of sexual activity as *Coch-hominivorax* and possibly also only mate once like that species. Eventhough numerous matings were seen, no eggs were laid, even when they were reared up to 14 days of age.

Eggs of *C. bezziana* were never seen either on fresh or already struck wounds. Eggs of other species of flies were often seen on the edge of struck wounds. Attempts to rear first and second stage larvae on blood, fish, tissue of dead animal, and papaya failed. Third stage larvae measured about 12 - 15 mm. long, creamy-pinkish in colour. The larvae probably attained maximum growth at the minimum of 6 days after the strike. It takes 7 - 10 days for the pupae to become flies. Majority of the flies in my culture emerged during the night, early and late morning and very few later in the afternoon.

## 7. Treatment and control measures

The treatment procedures that are adopted by this farm including properly cleaning of wounds, removal of the larvae, application of insecticide and Gusanex spraying. The wounds are treated until healed completely or until they appear dry. Antibiotics are given only to severe cases.

Since the fly C. bezziana only breed on fresh wound, so live animals must be the main source of flies. Therefore, all the larvae particularly those that have attained full size should be destroyed after removal from wounds, although some would die when exposed to the sun, or be eaten by ants, or trampled by animals, but their ability to burrow underground should be considered also. It would be better to treat the wound and surrounding areas beforehand with Gusanex to kill the larvae because some larvae would drop attempting to remove them from the struck wounds.

There were no reports of screw-worm fly adults or larvae developing genetic resistance to the active ingredient Lindane(14). Although the most commonly used screw-worm smear now (EQ 335), was highly effective in killing the larvae, it does not stand up to heavy rain and residues are persistent about 24 days in milk after treatment. So the use of Caumophos preparation was suggested (19).

On average each affected animals on this farm received five treatments but the number and frequency depends on the animal's temperament, severity of the strike, workers mood and weather conditions.

The steps being taken to control over the level of infestation involved regular checking of the animals at 2 - 3 day interval, prompt treatment of wounds careful attention to newborn calves umbilicus, tipping of horns, regulate calving season. In addition to those mentioned the use of hornless breeds or resistant

stock, limit use of barbed wire, deticking, well care of operation wounds and yards kept free of projecting nails or snags could also help to reduce the level of incidence.

The regular treatment of wounded animals with insecticide only reduce the incidence of strike but will not eradicate *C. bezziana*. So it is important to reduce the availability of wounded animals because this is the most essential factor determining the extent and abundance of the screw-worm fly infestation because there is no resting-phase in the life-cycle, so they must breed continuously to survive.

## 8. Economic importance

Although maggot wound is not the main problem on this farm, the high incidence and large number of cattle treated each year must involved some economic losses. The effect can be divided into as follows:-

### 8.1. Direct economic losses

#### 8.1.1. Loss of animals

In previous before five calves were reported as dying due to maggot wounds and two others associated with other diseases after being struck a few times. No fatality has been reported since then.

### 8.2. Indirect losses

### 8.2.i. Effects on growth and conditions

Struck animals no doubt experienced loss of weight during the course of the disease because after being struck they appear irritated, rubbing or licking the affected area. The animals look dull and lose their appetite, not eating and drinking and start to lose weight. However, once the larvae drop off or are removed, healing could be rapid and the animals start gaining weight again.

Repeated strike would interfere with growth performance particularly on animals during their growing stage. This effect is very important to beef-producing farms because the animals may not reach the weight desired within the period set.

Debilitated animals have lower body resistance and secondary infection could be more readily established.

Strike on the foot particularly at the interdigital space are very difficult to treat and takes longer to heal. Improper treatment affects the growth of the hooves and as the result they curl inwards. The area is constantly wet particularly in this farm because the animals always walk to the water area to drink and the grass is usually wet in the mornings. Without trimming the affected hoof, the wounds are slow to heal and can become more severe. This will interfere with the animal's gait and its ability to graze and thus effects its growth and weight gain rates.

If occurring on teats or udder this could lead to the loss of their function.

### 8.2.ii. Effects on breeding and fertility

Strike on the vulva might affect future breeding and fertility.

If severe enough, affected parts might have to be amputated. If strike occurs on the scrotum, even when moderately restricted in areas, it could be associated with degeneration of the sperm and lowered semen quality. When occurring on the penis, permanent paraphimosis or stenosis of the urethra can result. Severe strike on preputial region sometime could lead to penile phimosis.

#### 8.2.iii. Cost of preventive measures and treatment

The expenditure on management practices and preparations used for prevention and treatment is a proper charge against the flies.

##### 8.2.iii.a Drugs and chemical cost

If assumed that each animal was treated at a cost of 0.20 cents for first treatment and 0.03 cents for the following treatments, approximately \$950.00 was spent last year.

##### 8.2.iii.b Time and labour cost

Working from the facts that there are four units on this property, each unit is divided into four mobs, 1½ hours is the average time taken by 2 workers to muster, examine, treat and return each mob to its paddock, two-thirds of the mustering is purely for screw-worm control, each worker is paid \$300.00 per month, the annual labour cost of about \$7200.00 was incurred in screw-worm control.

##### 8.2.iii.c Other losses

Because the farm having limited number of workers, the period during

high incidence no doubt would interfere with other works on the property.

## 9. Discussion

The majority of the maggot wounds that occur in this farm and probably in this country are due to C. bezziana. The struck wounds remain highly attractive to other species of Calliphoridae and Muscidae but not to C. bezziana after the initial period.

Liver bait attracted very few flies probably because the amount that was used was very small, which dries very quickly and becomes unattractive to the flies. To be more effective in catching flies by using chemical baits, the chemical solutions should be less volatile. Liquid solutions like glycerol would possibly be used to decrease the rate of evaporation. Persistence of smell from the bait is essential to attract flies. There must be a compound that is present in fresh wounds that has an olfactory attraction to C. bezziana. Probably this compound is not present or is converted to other compounds in decomposed tissue. The chemical solutions used were less successful than suggested by American workers with Coch. hominivorax. The place where the traps were hung may also affect catch, although this was considered in trap placement.

There is a seasonal prevalence of strike on this farm and this perhaps reflects both seasonal activity and prevalence of adult C. bezziana. The highest incidence in the period between June and November is quite consistent from year to year. There may be little fluctuation in the adult C. bezziana population throughout the year but the seasonal incidence may be more likely due to greater fly activity during cloudy weather which then affects the routine management. The high incidence during the wet season probably is determined by the duration and amount of monthly rainfall, and the amount of sunshine and the relative humidity. High rainfall, high humidity and less sunshine are the most suitable

condition for the adult flies and eggs to survive. During the wet season, wounded animals cannot be treated as promptly and therefore the number of untreated wounds and therefore of larvae becoming flies is increased. The drugs applied also get washed off by rain.

During hot, dry weather, C. bezziana flies are probably restricted to areas where shade and moisture are readily available. Site of lesion may also influence the flies to lay their eggs. Adult females *Chrysomya* more readily oviposited their eggs on the wounds that are less exposed to sunlight.

Probably this species has been present here for sometime, the population being maintained by wild animals. The introduction of cattle which are more numerous and more favoured hosts would be expected to increase the fly numbers. The possibility of the flies coming from other areas surrounding this farm because of the ability of female gravid to flies long distance should not be excluded. The first case seen on this farm was two weeks after the cattle arrived.

To be effective in controlling strikes, the extent and the level of infestation, dispersal pattern of adults and their seasonal population abundance and activity should be investigated more thoroughly. Control or eradication programmes will need to make use of seasonal fluctuations in activity or prevalence.

The availability of wounded animals, climatic conditions favourable to the fly, together with shortage of experienced labour and effective remedies almost certainly will cause a rapid increase in numbers and spread of this pest.

Although an eradication programme through the release of sterilised irradiated males gave successful results in the United States, the justification of the enormous cost of this type of program considering to the size of our livestock population is doubtful. For most insects, the rearing, sterilization and release method alone will be impractical for regulating well established population because of the high cost of producing sterilised males in sufficient

numbers. There are unsolved problems of adapting and rearing of *C. bezziana* in laboratory culture and its response to sterilization techniques, the characteristics of the area to be treated and the existence within it of natural barriers which would permit piecemeal treatment only, it is doubtful whether it is practicable to distribute the flies to achieve eradication in the large areas of undeveloped and agricultural land in our country, to maintain a free area, production of irradiated males must be matched with a knowledge of the population dynamics, dispersal patterns and behavioural characteristic of wild populations in the area. A control zone along the border line must be maintained.

So it is important that other methods of biological or chemical control which will give same effect but at less expense, be developed.

The relative lack of attention that is given to the hazard of screw-worm infestation to our livestock industry is probably because of its small size. Our cattle industry is very labour intensive. Wages are very low with respect to the value of cattle when compared to temperate major livestock-producing countries. This is shown by this farm where frequent mustering of cattle with prompt attention to wounds is an accepted method of controlling losses due to screw-worm fly. Monthly incidence for last year (1979) was less than 10% which is an improvement on previous years. Smallholder cattle farmers because of small number of animals, they are able to pay close attention to their animals. In a major livestock producing countries like Australia, where beef cattle are yarded one to four times annually, the effect would be devastating. Presumably the large losses quoted as occurring in Southern U.S.A. are also due to less labour intensive management.

Eventhough this farm so far contributes only about 2% of the total beef required by this country, the effect of screw-worm strike on it, at least, can give a picture on how important and significant is the hazard of myiasis to cattle farms in this country and thus to our livestock industry as a whole and its future development.

## 10. Bibliography

1. A. Rahman Rama Krishna (1979): Pahangbif-personnal communication.
2. Anderson J.L.A. Cartley (1961): Screw-worm in New Guinea. Aust. Vet. J, 37:201
3. Bennett, G.F. Warren. McW & Ellison D.C. (1964)  
Chrysomia bezziana as a major hazard of the Malaysian National Zoo.  
Med. J. Malaya; 19:59
4. Calvin M. Jones, Delbert D. Dehler, J. Wendell Snow and Rolland R. Crabbe.  
A chemical attractant for screw-worm flies. J. Econ. Ent. 69.(3):389
5. Chandler A.C. (1955). Introduction to parasitology.  
9th. New York. John Wiley and Sons.
6. Chorley (1932). Report of the Chief Entomologist for the year ended 31 Dec. 1931  
Medical and Veterinary. Rhod. Agric. J. 29:524
  - Enamel (1945). The primary screw-worm fly. C. americana as a vector of joint ill in calves. JAVMA 106:223
8. Griffith. R.B. (1964). Cutaneous myiasis of cattle in Kuala Lumpur.  
Wed. J. Malaya 20:77
9. Hightower BG. Baumhover, Graham (1966). Seasonal abundance of the screw-worm  
in Northern Mexico J. Econ. Ent. 59(12):416
10. Institiut Haiwan Kluang - Lapuran Tahunan
  1. Mohd. Fadzil, Ahmad Jaafar, Cheah Tong Soon. (1971)  
Chrysomia bezziana (Villeneuve) Some observations on its activity in the  
Tekam Research Station, Jerantut, West Malaysia. Kajian Vet. 3(1):10
  - Mohd. Fadzil (1979). Personnel communication.
13. Norris KR. Murray MD (1964). Notes on the screw-worm fly C. bezziana:  
(Diptera:Calliphoridae) as a pest of cattle in New Guinea.
14. Oehler. B.D., Hogan B.F. and Graham O.H. (1970) J. Econ. Ent. 63:1467
  - Parman, Lindquist, Barrett, Brady, Rogers, Deonier, Parish (1945).  
Over-wintering Ecology of the screw-worm. J. Econ. Ent. 38:60
16. Patton W.S. (1920). Indian. J. Vet. Res. 8 - 17.
  - Patton W.S. (1922). Indian J. Med. Res. 9:635
  - Soulsby E.J.L. Helminths, Arthropods and Protozoa of Domesticated Animals.  
Sixth edition.
  - Southern Rhodenis (1942). Report of the Division of Ento. for the year  
(1941). (Jack R.W.) pp:19 (Type script) Vet. Bull 13. p:247 (1943)

20. Spadbery, Sand (1979). The screw-worm fly threat. Rural Research 102, March p.4
21. Stoddard H & Peck EF (1962). Fatal Strike caused by *C. bezziana* in cattle and buffaloes. Vet. Record 74:591
22. Zumpt: Myiasis in man and animals in the old world. London; Butterworth 1965.

