Department of Agriculture and Food
GOVERNMENT OF WESTERN AUSTRALIA

Journal of the Department of Agriculture, Western Australia, Series 4

Volume 25
Number 3 *1984*

Article 13

1-1-1984

Bush flies : where they all come from

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BUSH FLIES
— where they all come from

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The bush fly is a native Australian insect which breeds in dung and has had its reproductive opportunities greatly expanded by the introduction of cattle into the country.

In the agricultural region of south-western Australia bush flies appear in large numbers in spring and early summer. The occurrence of such massive numbers then can be traced back to short periods of very successful breeding that begin in the cool early weeks of spring when flies are hardly noticeable.

Breeding sites

The bush fly, *Musca vetustissima*, breeds only in the fresh faeces of large animals. For successful breeding it needs nutritious faecal matter that stays moist for the feeding period of its larvae. This lasts from about 5 days in hot weather to as long as 20 days in cold weather. The generation time from egg to mature adult ranges from just under two weeks in summer to about seven weeks in mid-winter.

Before the development of agriculture in Australia, the bush fly's major breeding sites would have been the faeces of humans, dogs, larger marsupials and emus. Such droppings are small and, from the omnivores and carnivores, are produced fairly infrequently. Up to 150 bush flies have been bred from a human or dog stool.

After cattle were introduced by Europeans, there was a dramatic increase in the supply of breeding material for the bush fly. Cattle droppings average two litres and each beast defecates about 12 times a day. Since more than 1,500 bush flies can be reared in one dung pad, the potential of a single beast for supporting flies is enormous. Cattle dung has become by far the major breeding site for the bush fly.

Seasonal distribution

Permanent bush fly populations are found in about half of the agricultural region of south-western Australia, north-east of a line from Dandaragan-Cunderdin-Newdegate. They die out in winter south-west of this line because it is too wet and cold for continuous breeding (see map).

Where flies are always present, fewest are found in late winter. After the build-up of populations in the north-east in early spring, bush flies migrate south-westwards and re-populate the area where there was no over-wintering.

The build-up of bush fly numbers in the north-east, and the subsequent migration, occur with remarkable regularity each year. There are enough flies in the over-wintering zone for migration to be noticeable by the first week of October and the migrants reach the far south-west by the end of October. Local breeding then increases populations in the south-west.

Causes of population increase

The size of each adult bush fly is determined entirely by larval size. This in turn depends on the suitability of the dung for development of larvae.

The nutritive value of cattle dung to bush fly larvae feeding in it varies seasonally in response to changes in pasture growth. Cattle feeding on green pasture produce dung that gives rise to large flies, while dung from cattle on dry pasture gives rise to small flies. In south-western Australia, where annual pastures predominate, bush flies are largest in winter-spring and smallest in summer.

Fly size determines the fecundity, or lifetime egg-laying capacity, of female bush flies. Large bush flies common in early spring may each lay about 55 eggs. In contrast, small flies common in summer may lay only about 18 eggs.

This large seasonal variation in fecundity plays an important role in determining changes in the size of fly populations. In spring, only about 4 per cent of the eggs need to survive to new adults for a female to replace herself and her mate in the next generation (zero population growth). The lower fecundity in summer, however, means that survival then needs to be about 11 per cent to maintain a stable population.

During much of the year the bush fly reproductive rate departs markedly from the stable zero population growth level. It is these occasions that cause either major rises or sharp falls in the number of bush flies.

In spring, the survival from egg to adult is 30 per cent or more. This, coupled with the high fecundity of the females, results in a ten-fold population growth rate per generation (see table).

After the spring upsurge in bush fly numbers, dung deteriorates as pastures die, flies are small and fecundity falls. At the same time more eggs, larvae and pupae die from attack by predatory insects and competition from dung beetles. Survival from egg to adult falls to about 1 per cent and fly numbers decrease, also by as much as ten-fold per generation.

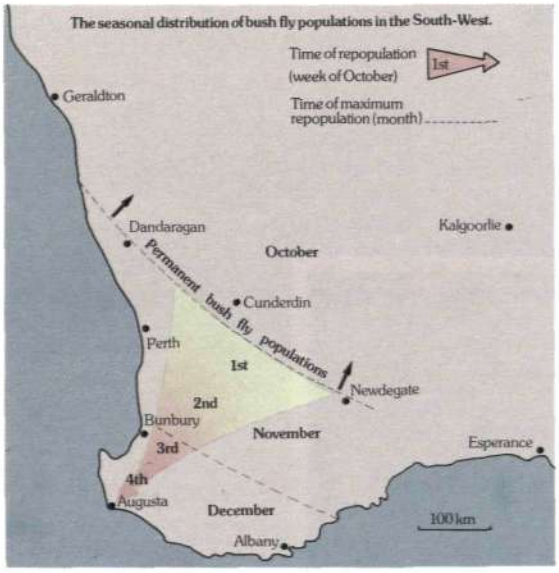
Major changes in bush fly numbers occur because changes in fecundity and survival have a simultaneous effect in the same direction. Thus, each factor enhances the effect of the other on the bush fly's reproductive rate, leading as the case may be to rapid rises or rapid falls in numbers.

Seasonal population patterns

In the north-eastern agricultural areas where the bush fly over-winters, high survival of larvae feeding in dung coincides with high fecundity each August—September. Their slow development because of cool weather means that the resulting build-up in the adult population is first noticeable in early October, with peak numbers late in that month. Further south-west, breeding is highly successful in October or November, just after re-population by immigrant flies, and the adult population is highest in November and December (see map).

The basic population process leading to high bush fly numbers is the same in all parts of south-western Australia. For the subsequent decline, however, there are two distinguishable areas where the processes differ.

In inland areas, such as the wheatbelt and Great Southern, the bush fly population in summer falls rapidly from its peak and stabilises at moderate levels. It appears that at these densities the bush fly reproduction rate levels at about zero population growth. The populations are maintained until winter when they either die out or persist at an almost unnoticeable level.



The other area is the south-west coastal fringe. There, the bush fly population falls to almost zero by mid-summer and never increases before dying out with the onset of winter. An example of this pattern is seen around Busselton where the bush fly population peaks at about Christmas and New Year and has all but disappeared by the end of January.

The nature of the processes that cause the two contrasting patterns are not entirely clear and are currently under investigation.

In areas where perennial pastures are irrigated during summer, the green feed results in more nutritious cattle dung for the bush fly than dung from cattle grazing surrounding dryland annual pastures. However, more eggs, larvae and pupae are drowned during regular flooding than die on the dry annual pastures. Bush fly populations in irrigated pastures therefore differ little from those in surrounding dryland areas because lower survival of immature stages offsets the benefit of better dung.

Strategy for control

The most rational control strategy for reducing the pest status of the bush fly in south-western Australia would be to prevent the massive build-up in numbers in spring.

During the mild spring weather fly numbers increase several weeks later than the beginning of the period during which survival of immature stages in dung is high. Survival should be suppressed the most when there is little sign of flies. The high fecundity of the large flies in spring also means that many more flies must be killed to attain the sub-zero population growth levels than when flies are small in summer. Bush fly populations therefore can best be reduced by killing two or three generations in spring.

How changes in total number of eggs laid per female (fecundity) and survival of eggs to adults interact to affect bush fly populations.

	Spring	Summer
Fecundity	55	18
ZPG survival	4%	11%
Actual survival	30%	1%
Population change	rapid increase	rapid fall

■ Large bush flies reared in nutritious cattle dung in spring and small bush flies from poor cattle dung in summer. Bush flies only breed in dung; blow flies breed in carrion.

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