A LARVAL HABITAT OF THE BITING MIDGE *CULICOIDES BREVITARSIS* KIEFFER (DIPTERA: CERATOPOGONIDAE)

By L. R. G. CANNON* and ERIC J. REYE†

[*Manuscript received February* 14, 1966]

Abstract

The finding of immature stages of *Culicoides brevitarsis* Kieffer in cow dung in south-east Queensland is described. The implications of such a habitat are that this may be a cosmopolitan species, hence that its status and relationships need clarification; that its potential as a vector of disease is increased thereby; and that it poses control problems in range management but should facilitate laboratory investigation of the species.

INTRODUCTION

In the course of an investigation into onchocerciasis in cattle by one of us (L.R.G.C.) the possibility of biting midges being vectors was considered. Species of subcoastal and inland distribution in the genus *Culicoides* known to attack cattle in Australia are *C. brevitarsis* Kieffer, *C. marksi* Lee and Reye, *C. dycei* Lee and Reye, and *C. victoriae* Macfie. *C. brevitarsis* is more commonly taken attacking cattle by stock inspectors than any other species and can, on geographical distribution as well as attack on cattle, be regarded as the first possible suspect as a vector of onchocerciasis (Lee, Reye and Dyce 1963).

C. marksi and *C. victoriae* (as *C. magnimaculatus* Lee and Reye) have been found breeding in pond margin situations (Lee and Reye 1953) and *C. dycei* has been related to gravelly stream margins (Reye, unpublished data). Attempts over many years to find immature stages or to collect adults of *C. brevitarsis* in emergence traps from such habitats have proved fruitless.

At Charleville, Queensland in 1955 it was observed (E.J.R.) that, in catches of this species by sweep-net, both total catch and male/female ratio were higher in the vicinity of empty stockyards and sheep pens than in adjacent paddocks, scrub, or near ponds or swampy ground. As light-trap catches presented a similar picture it was considered that *C. brevitarsis* might have its immature stages in dung or in heavily manured soil: until 1965 there was no opportunity to follow this clue.

The association of faecal contamination with larval habitats of *Culicoides* is not uncommon through the genus and species of human and veterinary importance have been found in areas with a high content of organic matter: for example, *C. variipennis* (Coq.), the vector of blue-tongue virus of sheep in the U.S.A., has been found in mud contaminated with faeces (Jones 1961); *C. nubeculosus* (Meig.), vector of the filarial worm *Onchocerca reticulata* of horses in England has been found in a similar habitat (Downes 1950); *C. obsoletus* (Meig.), a troublesome pest of man in the U.S.A., has been reported breeding in faeces contaminated straw and in manure piles (Weinburgh and Pratt 1962); and two other members of this group, *C. dewulfi* Goetgh. and *C. chiopterus* (Meig.) are found commonly in cow dung (Kettle 1962).

METHODS AND RESULTS

Investigations were carried out at the University of Queensland Farm at Moggill, near Brisbane, initially during July and August 1965. Fifty samples (each about one-fifth of a pat of dung) from thirty-eight cattle pats were searched for larvae in the manner used by Bidlingmayer (1957) for examining intertidal mud. The samples came from pats of varying ages estimated to be from three days to eight months old, and from various regions of these pats.

Larvae were found in ten samples taken from five of the thirty-eight pats, the number in these ten varying from one to fifteen with an average of four. These samples all came from the moist lower regions, and the type of pat from which they

*Department of Parasitology, University of Queensland. This part of the work was supported by the Australian Cattle and Beef Research Committee and was conducted under the supervision of Dr. D. E. Moorhouse.

†Department of Entomology, University of Queensland.

came was characterised by having a dry crust about 1 cm. in thickness and an interior with the consistency of wet canefibre board, there being no free moisture nor viscous centre. The age of such pats cannot be accurately given as the rate of attainment of these characters varied with the original consistency of the pat and the weather conditions to which it was exposed—in this instance the age was roughly estimated as from two to six weeks under the dry conditions prevailing at that time. Sampling in early summer (November) revealed larvae in pats having a small viscous centre though the larvae were found only in the zone of correct consistency between the centre and the crust.

Recovered larvae were reared on a sand slope half covered with cow-dung contaminated water. Pupae were found after one to twelve days in the culture. Each pupa was removed onto a moist cotton wool pad in the bottom of a small vial stoppered with cotton wool. Adults emerged within four to five days; sixteen adult females were reared from thirty-nine larvae.

The larvae did not show the rapid serpentine swimming characteristic of many known *Culicoides* larvae but lay on the bottom of the recovery dish performing a slow head to tail flexion at a rate of less than once per second. The pupae did not float to the surface either in the recovery dish or in the culture bottles but were generally found attached to submerged pieces of faecal debris. These characteristics may be an adaptation to life in dung as opposed to a more aquatic habitat and resemble rather the adaptation of species of the genus *Dasyhelea* Kieffer to life in algal surfaces and mats. The larvae and pupae will be described elsewhere.

During July 1965 twenty small emergence traps (made from waxed paper cups with the bottom replaced by organdie) were set over cattle pats in the field at Moggill. They were placed over various parts of a variety of pats viz. top only; side and edge; bottom half of pat after the top had been removed; the underside of an upturned pat; the soil beneath a pat. The traps were examined at daily intervals, two adults being recovered from one trap after twenty days. This trap had been placed over the side and edge of a pat which had the consistency mentioned earlier. Six of the traps had been placed over pats of this consistency, three being on side-and-edge, one on top, one on the underside of an upturned pat and one on the soil beneath.

Samples from a pat which had been found to contain larvae were placed in a container covered with organdie in the insectary at Moggill Farm under near constant conditions of 24°C and 80 per cent R.H. Three adult *C. brevitarsis* emerged within two days. Adults of this species have been recovered by the same method from cow pats in the laboratory on five subsequent occasions through to November. The numbers per pat were always of the same order with the sexes about equal.

Discussion

These investigations were made in the coldest part of the year in the first instance, the Brisbane air temperature ranging from 8.6°C to 19.5°C with a mean of 15.6°C while the mean grass temperature was 7.7°C with an extreme low of 1.6°C on 12th July. Subsequent work was done under continuing drought conditions relatively hostile both to adult midges and, we presume, to the development of favourable larval habitats in the pats. It may be expected, therefore, that these results do not reflect the numbers which might be present under optimal conditions.

The ability of *C. brevitarsis* to breed in cow dung suggests that it could be a cosmopolitan species distributed with cattle on board ships. If so, then some of the taxonomic problems which have been raised in the *orientalis* group, to which this species belongs, may be more varietal in nature than specific.

Buckley (1938) recorded *C. pungens* De Meij. as a vector of *Onchocerca* species in cattle in Malaya. Macfie (1937), recording *C. pungens* attacking cattle in Malaya, had felt that it was close to (and might be the same as) *C. grahami* Aust. from Africa and that *C. actoni* Smith might also be *C. pungens*: he remarked (1941) "It is possible that the specimens (366, all females) I assigned to this species may really have represented two distinct species, the one smaller than the other, and with shorter antennae. If so, the males when discovered may enable them to be separated, a step which on the characters of the females alone would not be justifiable".

Tokunga (1959) assigned to *C. orientalis* Macfie a male specimen from New Guinea which he later (1962) assigned to *C. brevitarsis* (as *C. robertsi* Lee and Reye) and in the same paper (1962) had some doubt as to whether he had correctly assigned a collection of ten females (also from New Guinea) to *C. pungens*. One of us (E.J.R.) has collected specimens in Fiji which appear close to, if not identical with, *C. brevitarsis*. On the other hand what has been taken to be variability within *C. brevitarsis* in Australia may be of more taxonomic significance than it appears to be. It is certain, however, that the status and relationships of the species in this group need clarification, especially if they are to be studied as potential or actual vectors of disease.

The close association of *C. brevitarsis* with cattle in pens, yards and, presumably, in camping places puts it in a good position to act as a vector of disease. Whether it bites more than once has yet to be proved, but should be more expected than not. *C. brevitarsis* has a wide distribution in Australia, being present over the greater part of Queensland, at least in that part with an annual rainfall of fifteen inches or more, in the northern half of New South Wales and in the Northern Territory (Reye 1964). The frequency of its capture by stock inspectors reported by Lee, Reye, and Dyce (1963) may be a reflection of the place of capture i.e. from animals yarded for inspection.

Should the need to control this species arise, the treatment of a dung habitat would provide interesting problems of range management. On the other hand such a habitat opens the possibility of a ready supply of laboratory reared insects and perhaps of laboratory colonies. This should greatly assist both taxonomic and biological study of the insect and make the investigation of its possibility as a vector of disease much easier.

We do not wish to give the impression that cow dung is the only possible habitat for larval *C. brevitarsis*. The dung of other livestock should at least be considered, as should that of native animals. Failure to find it in the latter and failure to rear larvae in such a habitat would lead to a strong presumption that it is a species recently introduced to Australia by man along with his livestock.

REFERENCES

BIDLINGMAYER, W. L. (1957).—Studies on *Culicoides furens* (Poey) at Vero Beach. *Mosquito News* **17** (4): 292-294.

BUCKLEY, J. J. C. (1938).—On *Culicoides* as a vector of *Onchocerca gibsoni* (Cleland and Johnston, 1910). *J. Helminth.* **16:** 121-158.

DOWNES, J. A. (1950).—Habits and life-cycle of *Culicoides nubeculosus* (Meigen). *Nature* **166:** 510-511.

JONES, R. H. (1961).—Observations on the larval habitats of some North American species of *Culicoides*. *Ann. ent. Soc. Amer.* **54** (5): 702-710.

KETTLE, D. S. (1962).—The bionomics and control of *Culicoides* and *Leptoconops* (Diptera: Ceratopogonidae = Heleidae). *Ann. Rev. Ent.* **7:** 401-418.

LEE, D. J. and REYE, E. J. (1953).—Australasian Ceratopogonidae (Diptera, Nematocera) Part VI. Australian Species of *Culicoides*. *Proc. Linn. Soc. N.S.W.* **77** (5-6): 269-394.

LEE, D. J., REYE, E. J., and DYCE, A. L. (1963).—"Sandflies" as possible vectors of disease in domesticated animals in Australia. *Proc. Linn. Soc. N.S.W.* **87** (3): 364-376.

MACFIE, J. W. S. (1937).—Notes on Ceratopogonidae (Diptera). *Proc. R. ent. Soc. Lond.* (B) **6:** 111-118.

MACFIE, J. W. S. (1941).—Notes on Ceratopogonidae (Diptera). *Proc. R ent. Soc. Lond.* (B) **10** (5): 67-69.

REYE, E. J. (1964).—The problems of Biting Midges (Diptera: Ceratopogonidae) in Queensland. *J. ent. Soc. Qd* **3:** 1-6.

TOKUNAGA, M. (1959).—New Guinea Biting Midges (Diptera: Ceratopogonidae). *Pacific Insects* **1** (2-3): 177-313.

TOKUNAGA, M. (1962).—Biting Midges of the Genus *Culicoides* from New Guinea (Diptera: Ceratopogonidae). *Pacific Insects* **4** (2): 475-516.

WEINBURGH, H. B., and PRATT, H. D. (1962).—"*Culicoides*, Public Health Importance, Biology, Survey, and Control". (U.S. Department of Health, Education and Welfare, Public Health Service, Communicable Disease Center, Atlanta, Georgia, 17 pp.)