AUTOGENY IN THE CERATOPOGONIDAE: LITERATURE AND NOTES

J. R. LINLEY
Florida Medical Entomology Laboratory
University of Florida, Institute of Food and Agricultural Sciences
P. O. Box 520, Vero Beach, FL 32961 USA

ABSTRACT

A brief review is presented, in the form of a species list with appropriate literature citations, of the occurrence of autogeny in the Ceratopogonidae. There are 38 species in which the phenomenon is now described. Notes on parthenogenesis, fecundity and ovarian development are appended.

RESUMEN

Se presenta un breve repaso, en forma de una lista de especies con citas bibliográficas pertinentes, sobre lo occurrencia de la autogénesis en la Ceratopogonidae. Existen 38 especies en las cuales el fenómeno ha sido observado. Se añaden notas adicionales sobre varios puntos de interés.

It is commonly observed that the literature tends to grow quietly and sometimes without being noticed as much as it should. When I recently finished a list of the autogenous species of Ceratopogonidae, the final compilation of 38 species came as something of a surprise. Since Glukhova and Dubrovskaya (1972) had earlier mentioned only 20 species (total reported), it seemed useful to provide an updated review. It has purposely been kept in the simple form of an alphabetical species list, with appropriate literature citations (Table 1). Accompanying notes emphasize points of interest or certain clarifications regarding the identity of species or the evidence for autogeny when this seemed less than completely conclusive.

The Russian fauna has been surveyed quite extensively, such that Glukhova and Dubrovskaya (1972) were able to indicate 6 of 21 Russian species as being autogenous. They also listed the Russian publications referring to autogeny or anautogeny in these species and the localities in which the studies were made. Since I have not read all these Russian papers in the original, I have not copied the citations into Table 1. A translation of Glukhova and Dubrovskaya (1972) is available (I am grateful to E. T. Schmidtmann and B. A. Mullens for this translation), to which I refer the reader. A few citations from the Russian literature are given and these are papers that have been available in translation for some time. Table 1 is given below and, following it, the notes.

Dasyhelea spp.

Although specific documentations appear to be lacking, autogeny is thought to be very widespread and perhaps universal in this genus of over 300 species (e.g. Downes 1955).

Culicoides obscuripennis

The report of autogeny in this species is referred to Murphy (1961), but

TABLE 1. AUTOGENY IN THE CERATOPOGONIDAE: SPECIES AND LITERATURE CITATIONS.

Species	Literature source
Culicoides alaskensis Wirth	Downes (1958)
C. austeni Carter, Ingram and Macfie	Murphy (1961)
C. bambusicola Lutz	Lee (1968)
C. barbosai Wirth and Blanton	Linley (1965)
	Linley (1966)
C. belkini (Wirth and Arnaud)	Duval et al. (1978)
C. bermudensis Williams	Williams (1961)
C. brevipalpis Delfinado	A. L. Dyce (pers. comm.)
C. circumscriptus Kieffer	Glukhova (1958)
	Becker (1960)
	Boorman and Goddard (1970b)
	Glukhova and Dubrovskaya (1972)
C. dendrophilus Amosova	Amosova (1959)
	Glukhova and Dubrovskaya (1972)
C. furens (Poey)	Linley (1965)
	Linley (1966)
	Linley (1969)
	Linley et al. (1970)
	Koch and Axtell (1978)
C. filicinus Gornostaeva and Gachegova	Glukhova and Dubrovskaya (1972)
C. gigas Root and Hoffman	Downes (1958)
C. hollensis (Melander and Brues)	Koch and Axtell (1978)
C. impunctatus Goetghebuer	Boorman and Goddard (1970b)
C. machardyi Campbell and Pelham-Clinton	Glukhova and Dubrovskaya (1972)
C. mackerrasi (Lee and Reye)	Dyce and Murray (1967)
C. marmoratus (Skuse)	Kay (1973)
C. melleus (Coquillett)	Henry and Adkins (1973)
	Linley and Hinds (1976)
	Koch and Axtell (1978)
C. mississippiensis Hoffman	Davis (1981)
C. obscuripennis Clastrier and Wirth	Murphy (1961)
C. praetermissus Carter, Ingram and Macfie	Dipeolu and Ogunrinade (1976)
C. pycnostictus Ingram and Macfie	Dipeolu and Ogunrinade (1976)
C. riethi Kieffer	Glukhova and Dubrovskaya (1972)
	Boorman (1974)
C. salinarius Kieffer	Glukhova and Dubrovskaya (1972)
C. segnis Campbell and Pelham-Clinton	Boorman and Goddard (1970a)
C. subimmaculatus Lee and Reye	Edwards (1982)
C. sanguisuga (Coquillett)	Jamnback (1965)
C. waringi (Lee and Reye)	Dyce and Murray (1967)
C. variipennis albertensis Wirth and Jones	Downes (1958)

TABLE 1. CONTINUED.

Species	Literature source
C. wisconsinensis Jones	Mullens and Schmidtmann (1981)
Leptoconops (*Holoconops*) *bequaerti* (Kieffer)	Linley (1968)
L. (*H.*) *kerteszi* (Kieffer)	Majori et al. (1970) Rees et al. (1971)
L. (*H.*) *linleyi* Wirth and Atchley	Linley (1982)
Leptoconops (*Leptoconops*) *bezzii* (Noé)	Bettini et al. (1969a)
L. (*L.*) *carteri* Hoffman	Schmidtmann (1976) Schmidtmann and Washino (1982)
L. (*L.*) *irritans* (Noé)	Bettini et al. (1969b)
Forcipomyia inornatipennis (Austen)	Kaufmann (1974)
F. squamipennis Ingram and Macfie	Kaufmann (1975)
Dasyhelea spp.	See notes

Culicoides obscuripennis is not named in Murphy's paper. It is the species he refers to as breeding in mangrove swamps and distinguishable, by virtue of its pronounced melanism, from *C. austeni*. Cornet et al. (1974) have discussed the identity of species studied by Murphy and have pointed out that this dark species was redescribed as *C. obscuripennis* by Clastrier and Wirth (1961).

C. praetermissus, C. pycnostictus

The evidence for autogeny in these 2 species (Dipeolu and Ogunrinade 1976) seems fairly conclusive. The authors found the ovarian follicles in various stages of development, from Mer's Stage I to Stage IV, in newly emerged females of both species. The fat bodies seemed more generously developed at emergence than in species judged to be anautogenous.

C. segnis

Evidence for autogeny in this species, while inconclusive, is at least suggestive. Boorman and Goddard (1970a) found that most females taken in light traps were gravid, yet none was ever seen engorged or with traces of blood.

AUTOGENY AND PARTHENOGENSIS

In addition to being autogenous, there are 2 species in which parthenogenesis is confirmed. In Bermuda, Williams (1961) managed to keep 2 virgin females of *C. bermudensis* (reared singly from larvae) alive for long enough to obtain a total of 38 eggs. All of these hatched within 48 h. *C. bermudensis* is also suspected of being paedogenetic (Kline and Axtell 1977). In Colombia, Lee (1968) observed embryonation in eggs produced autogenously and laid by virgin *C. bambusicola*. Becker (1961) suspected, but did not specifically demonstrate parthenogenesis in *C. circumscriptus* in Scotland.

Precocious Development of Eggs

There are a few species in which the condition of the ovaries has been examined at the time of emergence of autogenous females from the pupa. In some of these, ovarian development is precocious in the sense that the follicles are well advanced towards maturity in freshly emerged adults. In Jamaica, a small form of *Leptoconops* (*H.*) *becquaerti* was autogenous (the large form from the same larval habitats was not), and 97.5% of follicles in females dissected within 3 h of emergence were in early Stage IV of development (Linley 1968). The closely related species, *L.* (*H.*) *linleyi* was recently examined (Linley 1982) and is similar. In females less than 1 h old, 68.0% of the follicles were in early Stage IV. Among *Culicoides*, females of *C. barbosai* and *C. furens* at emergence had ovaries developed to Stages IIB and III, and IIA and IIB, respectively (Linley 1966). Newly emerged *C. dendrophilus* had ovaries in Stages IIA to III (Amosova 1959), and in *C. waringi*, ovaries were in Stages IIB or III (Dyce and Murray 1967). Mullens and Schmidtmann (1981) have recently examined female *C. wisconsinensis* within 30 min of emergence and found most follicles already in late Stage III.

Variable Prevalence of Autogeny

Prevalence is a term used to denote differences between localities with respect to the proportion of the population in which autogeny occurs. A few species are known to show such variation. In 2 Jamaican populations of *C. barbosai*, for example, 97% and 72% of the females produced eggs autogenously, while among 6 populations of *C. furens*, the proportions varied from 91% to 0% (Linley 1966). The collections were simultaneous and the collection sites in both instances were only a few miles apart. When the *C. furens* population at Vero Beach, Florida, was examined weekly for 13 months, all females from emergence traps produced eggs autogenously (Linley et al. 1970). *C. hollensis* from North Carolina has been described as autogenous by Koch and Axtell (1978), but all individuals from South Carolina were anautogenous (Henry and Adkins 1973).

Seasonal Variation in Fecundity

C. furens (Linley et al. 1970) and *C. melleus* (Linley and Hinds 1976) populations in Florida have been sampled continuously for slightly over a year in each case to measure seasonal changes in size and fecundity of the autogenous females. All females collected in both populations throughout the year produced a first batch of eggs autogenously. The seasonal trends in size and fecundity were similar, with female size (measured by wing length) inversely proportional to ambient temperature and fecundity substantially higher in larger females that emerged in the cooler months. The numbers of eggs matured per female varied seasonally by about a factor of 2 in the *C. furens* population, and 3 in the *C. melleus*.

Multiple Egg Batches Produced Autogenously

Schmidtmann (1976) and, more comprehensively, Schmidtmann and Washino (1982) have reported evidence indicating that, in some populations

of *Leptoconops* (*L.*) *carteri*, the females produce not only the first clutch of eggs autogenously, but also achieve autogenous development of the secondary follicles (in now parous flies) to early Stage IV. This situation is unique in Ceratopogonidae within the context of present knowledge. Studies to confirm and further define the phenomenon would be valuable.

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MATING BEHAVIOR OF WILD *ANASTREPHA FRATERCULUS* (DIPTERA: TEPHRITIDAE) ON A CAGED HOST TREE

JOAO S. MORGANTE, ALDO MALAVASI
Departamento de Biologia, Instituto de Biociências,
Universidade de São Paulo. Caixa Postal 11.461—S. Paulo
S. Paulo, Brazil

AND

RONALD J. PROKOPY
Department of Entomology, University of Massachusetts,
Amherst, MA 01003, USA

ABSTRACT

The mating behavior of the South American fruit fly, *Anastrepha fraterculus* (Wiedemann) is described, following release of wild virgin flies onto a field-caged host tree (guava). Sexual encounters and attempted copulations occurred almost exclusively from 0700-0900 hours and were confined to leaf nodes or the bottom surface of leaves, where males stationed themselves, often forming leks, and appeared to emit a sex pheromone which was attractive to virgin females. There were no male visitations or sexual encounters on green guava fruit, even though females, after mating, frequently oviposited there.

RESUMEN

En este trabajo se describe el comportamiento sexual de la mosca de frutas suramericana, *Anastrepha fraterculus* (Wiedemann), en el arbol de guayaba, el cual fue cubierto por una tela para confinar las moscas virgenes. Los encuentros sexuales y tentativas de copulación ocurrieron casi exclusivamente entre 0700-0900 horas, principalmente en los peciolos en la face in-