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Bionomic parameters of farm associated *Culicoides* species in laboratory conditions

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Introduction

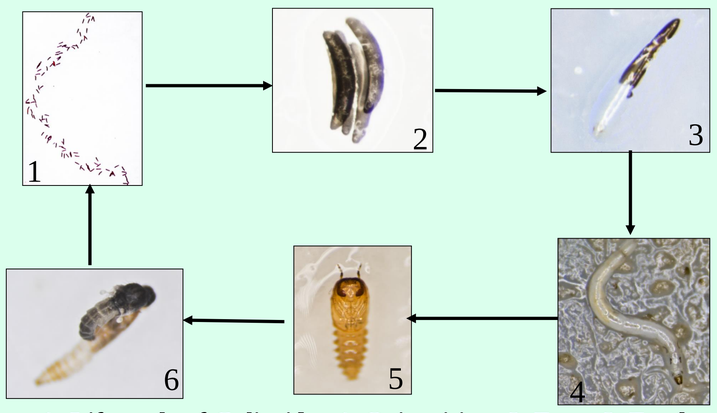

Figure 1: Life-cycle of *Culicoides*. 1. Oviposition; 2. Eggs; 3. Egg hatching L1; 4: L4 instar larva; 5: Pupa; 6: Adult emerging

Biting midges (Diptera; Ceratopogonidae) transmit several viruses which are responsible for important diseases, such as Bluetongue, African Horse Sickness, Epizootic Haemorrhagic Disease and recently Schmallenberg virus. To date, limited information is available about the basic bionomics of the major *Culicoides* vector species and other species associated with farm habitats.

In this work we contribute to the knowledge of the bionomics in laboratory conditions of the vector Obsoletus complex species and *Culicoides imicola* as well as other non-vector species such as *C. newsteadi*, *C. cataneii*, *C. paolae* and *C. circumscriptus*.

Material & Methods

Culicoides species were collected from field using a Onderstepoort light trap during 25 non-consecutive nights between April and November 2014 in a cattle farm (*Son Valls*) located in Mallorca (Balearic Islands, Spain). Gravid females were kept individually in 64 mm cardboard boxes (Fig. 2). A plastic Petri dish (Ø = 5 cm) in the bottom of the cup with moist cotton wool and filter paper on the top provided a surface where eggs were laid. Eggs were transferred to a 100 mm Petri dishes with 10 ml of 2% bacteriological Agar gel medium. The larvae were grown in the agar medium fed with *Panagrellus redivivus* nematodes and pupae were transferred again to cardboard boxes till adults emerge. Bionomic parameters were observed daily and are presented below.

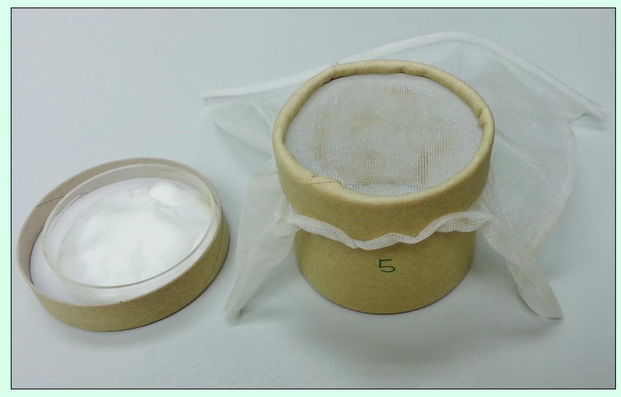

Figure 2: Cardboard box used to keep gravid females collected from the field

Results

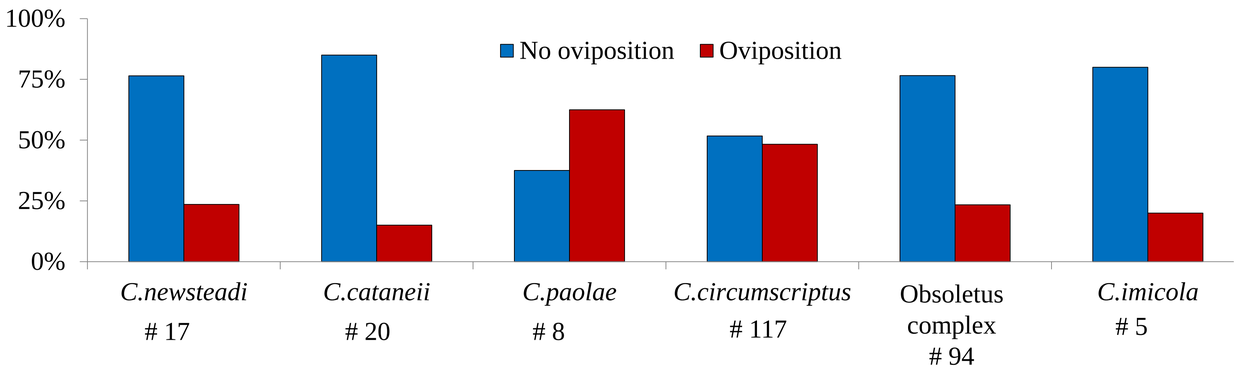

Figure 3. Percentage of field gravid females oviposition versus females which not oviposit (#)= Total number of field gravid females used for the experiment.

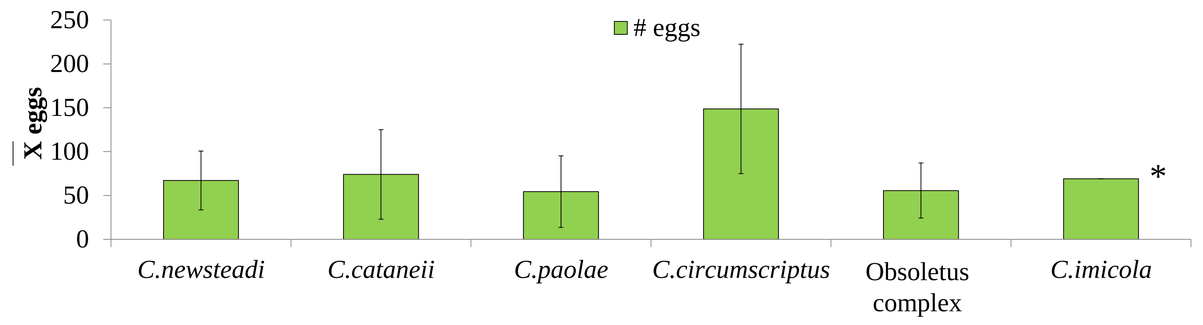

Figure 4. Average of eggs laid for each gravid females species. (*)= *C.imicola* eggs based in only one individual

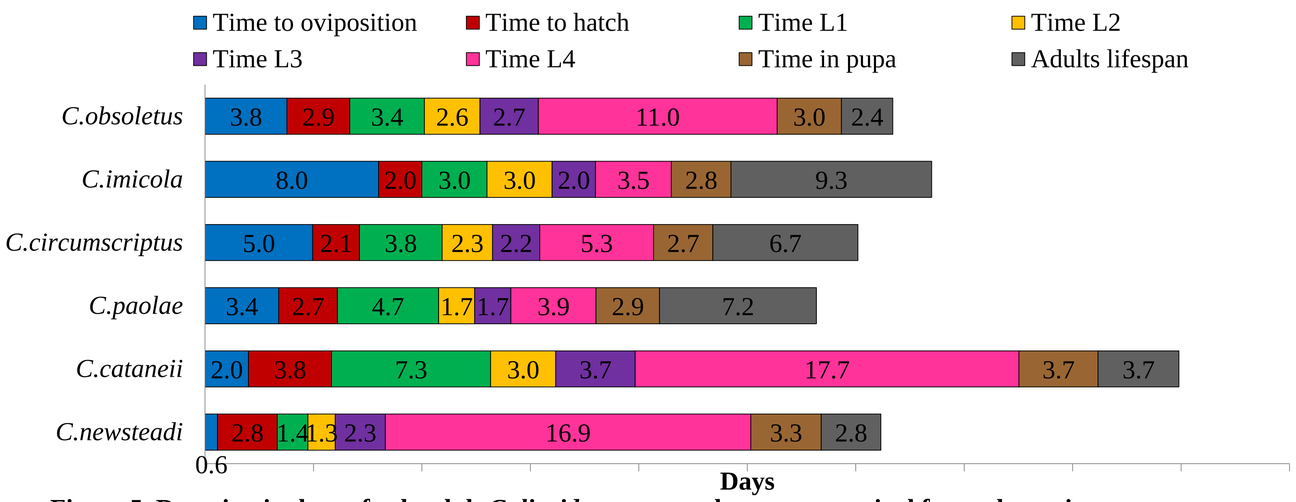

Figure 5. Duration in days of sub-adult *Culicoides* stages and progeny survival for each species.

Table 1. Percentage of egg hatching, larvae pupation and adults emerged for each *Culicoides* species . (*)= *C.imicola* eggs based in only one individual

Specie	%hatch	%pupae	% emerged
C. newsteadi	41.8±20.9	9.2±10.7	68.3±37.3
C. cataneii	99.2±32.3	11.8±8.7	90.5±25.6
C. paolae	51.5±34.3	34.5±26.7	98.7±4.9
C. circumscriptus	70.4±33.9	55.4±27.0	91.3±17.1
C. imicola	76.8*	26.1*	83.8±2.8
C. obsoletus	62.3±37.9	41.2±24.8	86.0±38.1

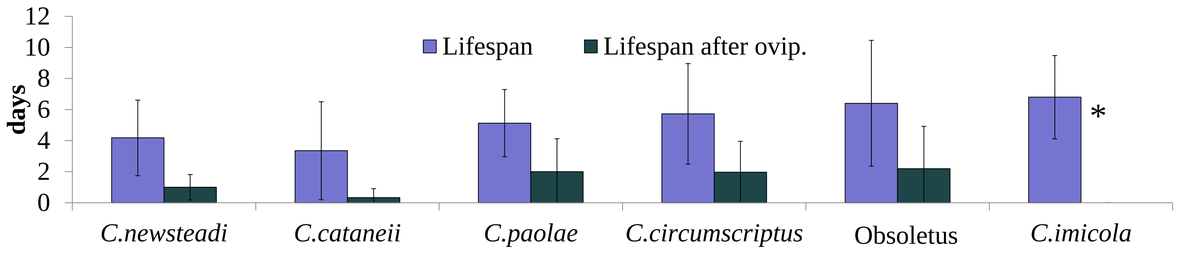

Figure 6. Lifespan of field gravid females and lifespan after oviposition. (*)= *C.imicola* lifespan based in only one individual which died immediately after oviposition

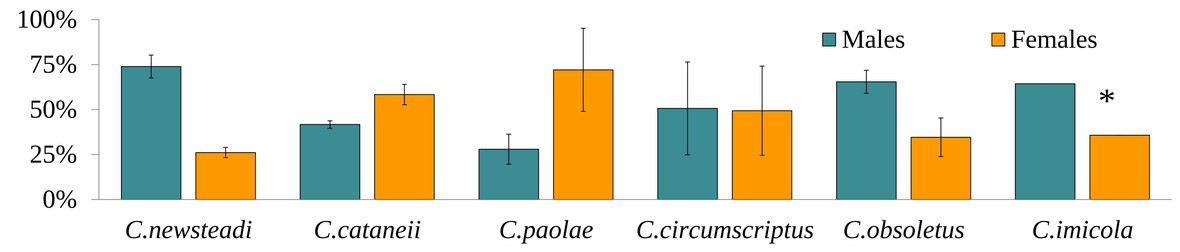

Figure 7. Percentage of males and females of F1 emerged in laboratory. (*)= *C.imicola* progeny based in only one individual

Conclusions

- The higher number of eggs was laid by *C. circumscriptus* ($\bar{x}$ 148.7) followed by *C. cataneii*, *C. imicola* (*), *C. newsteadi*, Obsoletus complex and *C. paolae* (Fig.4)
- *C. circumscriptus* and *C. paolae* would be the most appropriate species to rear in laboratory conditions due to its higher oviposition rates (Fig.3), fastest life-cycle (Fig.5) and high females percentage (Fig.7).
- *C. obsoletus*, *C. cataneii* and *C. newsteadi* had the longer life cycle due to its longer L4 larvae stage (Fig.5).
- Pupation demonstrated to be the limiting factor in *Culicoides* breeding in laboratory conditions (Table 1).
- Field gravid females of *C. obsoletus* showed the higher lifespan (Fig.6), therefore, this could have important implications in arbovirus transmission in comparison to other vector species.
- The % of F1 females was higher in *C. cataneii* and *C. paolae* , meanwhile *C. circumscriptus* had a similar percentage of males and females (Fig.7).