Blue craneflies in Finnmark, a putative case of *Iridovirus* infection (Diptera, Tipulidae; Iridoviridae)

LOUIS BOUMANS & ESPEN AARNES

Boumans, L. & Aarnes, E. 2010. Blue craneflies in Finnmark, a putative case of *Iridovirus* infection (Diptera, Tipulidae; Iridoviridae). *Norwegian Journal of Entomology* 57, 120–122.

A copula of brightly coloured blue craneflies were photographed in Finnmark, northern Norway. The species is identified as *Tipula (Beringotipula) unca* Wiedemann, 1817, and the blue colour is hypothesised to result from a blatant infection with an invertebrate iridovirus (IIV). It is the first report of a naturally occurring putative IIV infection in adult craneflies.

Keywords: invertebrate iridovirus, adult cranefly, Tipulidae, Iridoviridae

Louis Boumans, Natural History Museum, University of Oslo, PO Box 1172 Blindern, NO-0318 Oslo, Norway. Email: louis.boumans@ nhm.uio.no.

Espen Aarnes, Bioforsk Jord og miljø Svanhovd, 9925 Svanvik

Introduction

On 11 July 2010 Espen Aarnes photographed a copula of blue craneflies in Sør-Varanger, Finnmark, outside his home in home in Svanvik (UTM 36W UC849079). The two pictured craneflies were the only blue specimens seen, and Fig. 1 is the only documentation of this sighting. About two weeks later, Louis Boumans visited the nearby Svanhovd Conference Centre in Svanvik. Hearing about the sighting of blue craneflies, he tried to find them as well. The only craneflies he found were specimens of both sexes of *Tipula (Beringotipula) unca* Wiedemann, 1817 in their usual yellow and dark colour pattern. While Aarnes' picture does not allow for an unequivocal identification, it appears to show the same species, an opinion shared by cranefly experts Pjotr Oosterbroek (Amsterdam) and Tony Irwin (Norwich).

As the most plausible explanation for their blue colour, we suggest a high concentration of particles of an invertebrate iridovirus (IIV, Iridoviridae) of the genus *Iridovirus*. The blue colour is very similar to that which results from an IIV infection in woodlice, where such patent infections are a common phenomenon.

Iridovirus

The research on iridoviruses is reviewed by Williams et al. (2005). The large (120–300 nm) iridoviruses, characterised by a capsid with 20-sided (isocahedral) symmetry, accumulate primarily in fat and epidermis cells. They have been found in a range of invertebrates and cold-blooded vertebrates. The iridescence phenomenon occurs only with invertebrate iridoviruses (IIV), and is explained by the crystallisation of self-assembling virus particles which occurs at high concentrations. The bluish colours are typical for the smaller particles of the genus *Iridovirus* (Williams 1996; Williams et al. 2005).

The first IIV isolated was actually found in England in larvae of the cranefly *Tipula (Tipula) paludosa* Meigen, 1830 (Xeros 1954). Elliott et al. (1977) report on a further isolate from a *Tipula* sp. larva. Naturally occurring iridovirus infections have since been reported for over a

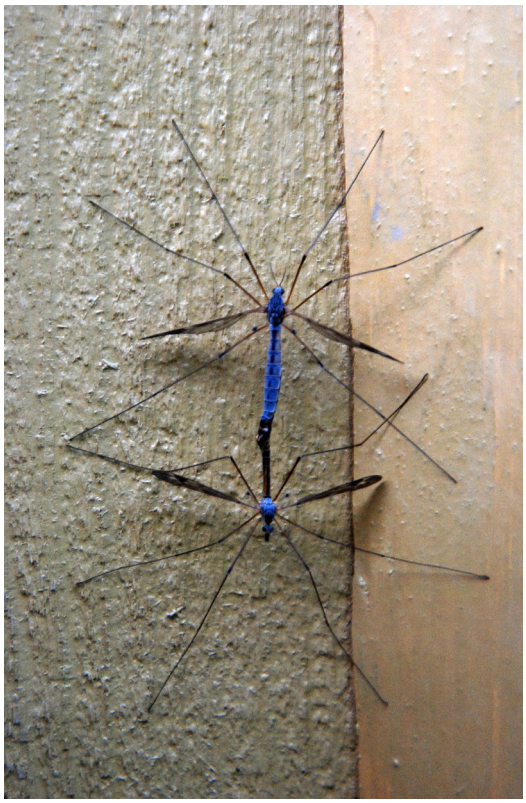

FIGURE 1. Blue craneflies, *Tipula cf. unca*, in Svanvik, Sør-Varanger, 11 July 2010 (Photo: Espen Aarnes).

hundred confirmed or putative invertebrate hosts, including many diptera species with aquatic larvae (Williams 2008). In laboratory experiments, iridescent adults of *T.* (*Tipula*) *oleracea* Linnaeus, 1758 were obtained from specimens infected at the fourth and last larval instar or the pupal stage, though many individuals died before reaching the adult stage as a result of the treatment (Carter 1974).

Little is known about the route of infection under natural conditions. Infection can result from feeding on infected animals (Carter 1973a, b) and from parasites, notably nematodes, penetrating the host hemocoel (Mullens et al. 1999). The virus does not withstand desiccation. Low temperature and moist or wet conditions enhance the extra-host persistence of the virus in the soil (Reyes et al. 2004), which may explain why natural infections are often found in Diptera with aquatic larvae (Williams 2008). Covert infection with *Iridovirus* appears to be rather common in many insects, and apparently innocuous infections alternate with lethal ones in the same host populations (Tonka and Weiser 2000; Williams 1995).

Discussion

Naturally occurring adult craneflies that turned blue have not been reported before. To find two of these in copula is most unlikely, although one may expect that blue craneflies, regardless of the explanation, are not randomly distributed. Yet the observation and picture are authentic, and an IIV seems to be the most plausible explanation. The larval habitat of *T. unca* is consistent with the prevalence of IIV in moist environments. The larvae develop in wet substrates like seepages, marshlands and mosses along streams; see Oosterbroek (s.a.) for a compilation of the literature.

It is unfortunate that the photographed craneflies were not collected for further research. However, in spite of the admittedly scarce evidence, we think the finding is remarkable enough as to be shared with a wider audience of interested zoologists. If it shows an IIV infection as we think, this photograph represents a putative new host record as well as a highly unusual record of patent infection of adult craneflies. If further blue craneflies are found, the finder is advised to collect the specimens and preserve them in a 50% sugar or glycerol solution, or frozen in water or glycerol. Ethanol destroys the virus (T. Williams, pers. comm.).

Acknowledgements. We wish to thank Trevor Williams, Pjotr Oosterbroek and Tony Irwin for their kind advice and helpful feedback on the picture.

References

Carter, J.B. 1973a. The mode of transmission of *Tipula* iridescent virus : I. Source of infection. *Journal of Invertebrate Pathology* 21, 123–130.

Carter, J.B. 1973b. The mode of transmission of *Tipula* iridescent virus : II. Route of infection. *Journal of Invertebrate Pathology* 21, 136–143.

Carter, J.B. 1974. *Tipula* iridescent virus infection in the developmental stages of *Tipula oleracea*. *Journal of Invertebrate Pathology* 24, 271–281.

Elliott, R., Lescott, T. & Kelly, D. 1977. Serological relationships of an iridescent virus (type 25) recently isolated from *Tipula* sp. with two other iridescent viruses (types 2 and 22). *Virology* 81, 309–316.

Mullens, B., Velten, R. & Federici, B. 1999. Iridescent virus infection in *Culicoides variipennis sonorensis* and interactions with the mermithid parasite *Heleidomermis magnapapula*. *Journal of Invertebrate Pathology* 73, 231–233.

Oosterbroek, P. (s.a.). *Catalogue of the Craneflies of the World* (Diptera, Tipuloidea: Pediciidae, Limoniidae, Cylindrotomidae, Tipulidae) Available: http://nlbif.eti.uva.nl/ccw/index.php [accessed 16 September 2010].

Reyes, A., Christian, P., Valle, J. & Williams, T. 2004. Persistence of Invertebrate iridescent virus 6 in soil. *BioControl* 49, 433–440.

Tonka, T & Weiser, J. 2000. Iridovirus infection in mayfly larvae. *Journal of Invertebrate Pathology* 76, 229–231.

Williams, T. 1995. Patterns of covert infection by invertebrate pathogens: iridescent viruses of blackflies. *Molecular Ecology* 4, 447–458.

Williams, T. 1996. The iridoviruses. *Advances in Virus Research* 46, 345–412.

Williams, T. 2008. Natural invertebrate hosts of iridoviruses (Iridoviridae). *Neotropical Entomology* 37, 615–632.

Williams, T., Barbosa-Solomieu, V. & Chinchar, V. 2005. A decade of advances in iridovirus research. *Advances in Virus Research* 65, 173–248.

Xeros, N. 1954. A second virus disease of the leatherjacket, *Tipula paludosa*. *Nature* 174, 562–563.

Received: 17 September 2010
Accepted: 8 Ocotber 2010