Flight Stability in Flies

Anthony Thomas (Canada)

As the scientific name (Order: Diptera) indicates, flies have 2 wings. Species in most other insect orders have 4 wings. Dragonflies (Order: Odonata) with 4 wings are skilful insect aeronauts that achieve such mastery of the air by being able to move the forewings independently of the hindwings. Other 4-winged insects normally lock the fore- and hind-wings such that all the wings move in unison. This likely results in more efficient flight in the sense of energy needed but limits maneuverabity.

Flies have kept their forewings but have reduced and modified their hind wings into a pair of rigid rods each with a knob on the end. These are the halteres which function as sensory organs concerned with the maintenance of stability during flight. The centre of gravity for a haltere lies in the end knob so that during flight the knob vibrates and these vibrations pass along the rigid rods to the flexible base connected to the thorax. Mechanoreceptors in the form of groups of campaniform sensilla allow the fly to correct its flight to control pitch, roll and yaw.

Halteres are particularly large in the less specialized flies such as Crane Flies (Family: Tipulidae) and Winter Crane Flies (Family: Trichoceridae). These latter insects are active during the colder months in Canada and are common in my garden at this time of the year (December). Below are some images of the halteres and their plates of sensilla.

Figure 1 is an image of a live **Winter Cranefly**, *Trichocera* sp., showing the large forewings and the just-visible knobs of the halteres.

Fig. 1. Dorsal view of a Winter Cranefly, halteres just visible below forewings.

Figure 2 is the same fly with the forewings moved forward to show the halteres.

Fig. 2. Dorsal view of a Winter Cranefly showing the relatively large halteres.

Figure 3 is a closeup of a haltere.

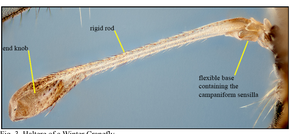

Fig. 3. Haltere of a Winter Cranefly.

Figure 4 is a closeup of a haltere base showing the sensilla plates. Stacked image through the full depth of the base with underlying parts showing through (40x objective + 1.25x intermediate lens + 2.5x relay lens, Nikon D600 camera).

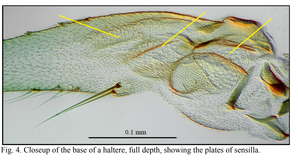

Fig. 4. Closeup of the base of a haltere, full depth, showing the plates of sensilla.

Figure 5 is a selective-focus of the ventral surface (as seen on the slide) of the haltere base emphasizing the lower sensilla plate.

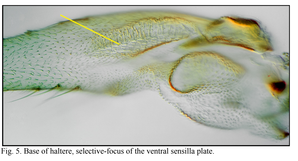

Fig. 5. Base of haltere, selective-focus of the ventral sensilla plate.

Figure 6 is a selective-focus of the dorsal surface (as seen on the slide) of the haltere base emphasizing the upper sensilla plates.

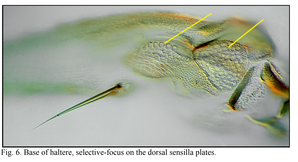

Fig. 6. Base of haltere, selective-focus on the dorsal sensilla plates.

Microscope and Photographic Equipment

My basic equipment is an Olympus BH2 with 2x, 4x, 10x, 20x, 40x, 60x, and 100x objectives; Olympus 2.5x NFK relay lens. I also have the components for Phase Contrast, DIC and Polarization. Camera is a Nikon D600 with Nikon PB-6 bellows; Nikon flash in place of Olympus' halogen lamp. For reflected light images I use Nikon CF objectives, El-Nikkor enlarging lenses, and a MF 105mm Micro Nikkor with a Nikon D90 camera. Most images are stacks of several frames processed by Zerene Stacker.

Email author: mothman@nbnet.nb.ca

First published in Microscape Magazine December 2012.

www.microscape.org