

The halteres and calyptera of the Diptera (Arthropoda: Insecta).

Carlos Henrique Marchiori¹

¹ Instituto Federal Goiano

Potential competing interests: No potential competing interests to declare.

Flies belong to the Order Diptera and have only one pair of membranous wings corresponding to the forewings, hence the name of the order. The posterior pair became two structures of reduced size, called dumbbells or halteres. Insects of this order have the first pair of membranous wings and the 2nd pair of wings are atrophied, forming the halteres, which are made up of a tapered part called the pedicel and an expansion at the end known as the capitellum. It is a non-functional wing that can only be used for stability in flight. Because of this, dipterans are considered to have only one pair of wings. [1-8].

The thorax is formed by 3 metamers: prothorax, mesothorax, and metathorax. The mesothorax is the most developed and consists of 3 regions: pre-shield, shield, and scutellum, and the suture that separates the pre-shield from the scutellum is called transverse suture. The only pair of wings originates from the mesothorax and has few longitudinal and transverse ribs, which are important for systematics [1-8].

On the posterior side of the base of the wing, some dipterans have 1 or 2 lobes called halteres. The metathoracic wings are reduced and called rockers or dumbbells. The legs have tarsi formed by 5 articles and the last ending with 2 nails, 2 pulvilli, and 1 empodium. The pulvilli are membranous, cushion-like structures located under the nails and the empodium is a structure located between the nails [1-8].

The halteres resemble sticks with a protrusion at the end and, during flight, they move in the opposite direction to that of the wings to maintain stability. Occasional changes in the direction of flight cause the nerve endings present in the structures to transmit information so that the animal does not lose control during rotations. They are also responsible for informing the insect about the speed and direction of flight, the presence of air currents, and its position, and are therefore essential for this action, and the characteristic humming sound of dipterans [1-8].

The halteres beat with the same frequency as the front wings and work like gyroscopes to compensate for flight instability. The rockers move in a specific direction during flight, a fly makes a sudden turn intentionally or because of a gust of wind the rocker rod twists the information is transmitted to the brain so the fly can make the necessary adjustments and maintain itself on the course. Therefore, flies are extremely agile and difficult to catch [1-8].

Calypterae is made up of flies that have a calyptera that covers the dumbbells, among which are some of the best-known of all flies, such as the house fly. The calyptera has the function of protecting the alters. The calyptra is one of the two posterior lobes of the posterior margin of the forewing of flies between the base of the extreme hindwing and the alula,

which covers the haltere. The lower calyptera is the proximal caliper, and the upper calyptera is the distal caliper (Figures 1-2) [1-8].



Figure 1. Two wings, the hind wings have evolved into balancing organs called halteres.

Source: <https://www.bobs-bugs.info/2013/12/20/diptera-true-flies/>.

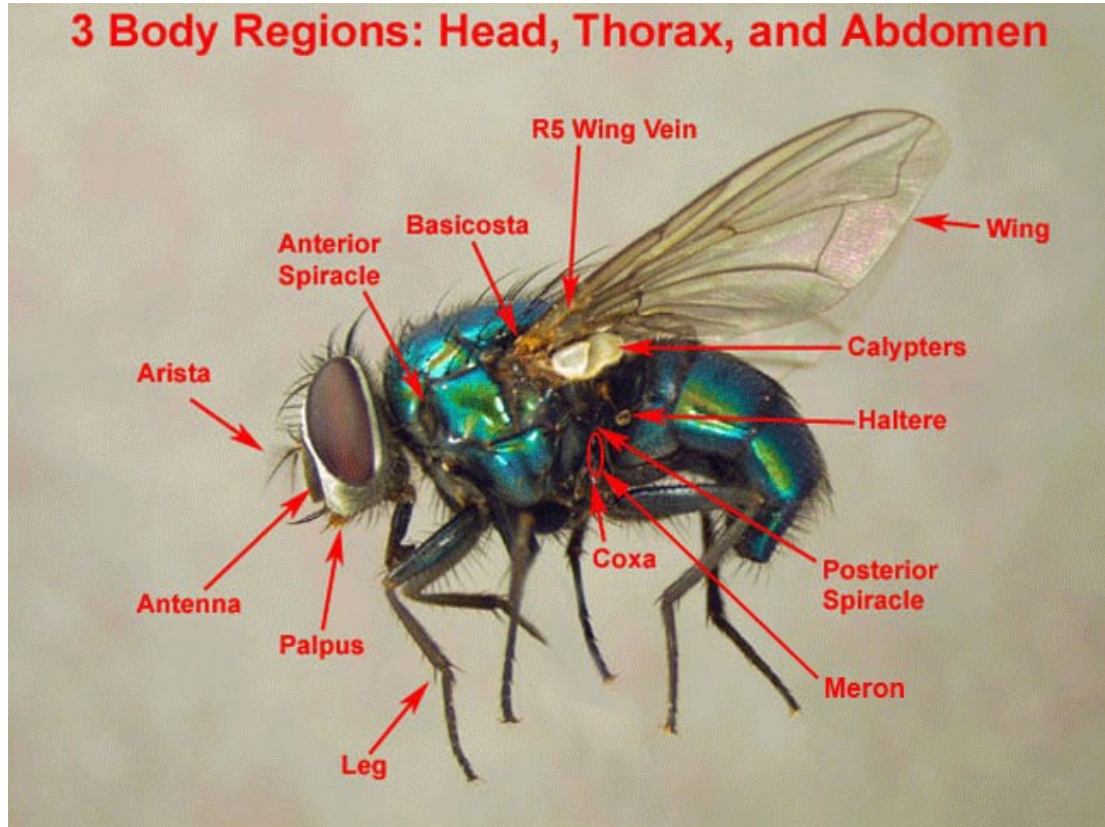


Figure 2. Fly Anatomy.

Source: <https://www.nku.edu/~dahlem/ForensicFlyKey/flyanatomy.htm>

References

- [1] Pringle JWS. The gyroscopic mechanism of the halteres of Diptera. Philosophical Transactions of the Royal Society B: Biological Sciences. 1948; 233 (602): 347-384.
- Dickinson MH. Haltere-mediated equilibrium reflexes of the fruit fly, *Drosophila melanogaster*. Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences. 1999; 354(1385): 903-916.
- [2] Gallo D, et al. Agricultural Entomology. 1st ed. Piracicaba: FEALQ. 2002.
- [3] Andrade LL. Flies [Internet]. Recife: Infoescola; @2024 [cited 2024 Feb 24]. Available from <https://www.infoescola.com/contato/>.
- [4] Paula Lima VP, Serra AL. Morphologic comparative analysis of wing venation of order Diptera (Linnaeus, 1758 – Arthropoda, Insecta). ConScientiae Saúde. 2008; 7(4): 525-533.
- [5] McAlpine JF, et al. Manual of Nearctic Diptera 1. 1st ed. Ottawa: Research Branch Agriculture Canada Monograph. 1981.
- [6] Kukalová-Peck J. Origin and evolution of insect wings and their relation to metamorphosis, as documented by the fossil record. Journal of Morphology. 1978; 156: 153-126.