Department of Environment and Conservation
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Information Sheet 15 / 2009
Science Division

Native flies attracted to bushfires

by David Klocke, Anke Schmitz and Helmut Schmitz, Institut für Zoologie, Universität Bonn, dklocke@uni-bonn.de

(Working in partnership with the Department of Environment and Conservation)

Background

Some native insect species respond to smoke and heat generated by bushfires (known as pyrophilous behaviour) and use very recent burns to reproduce. These species are more frequently found on freshly burned areas and are absent from, or rarely found in unburned habitats. Pyrophilous species are known in beetles, bugs, wasps, moths and also in flies. Some of these species evidently possess highly sensitive sensors to detect bushfire products such as infrared radiation and chemicals in smoke.

Within the flies, the members of the genus *Microsania* are called “smoke-flies” because they are irresistibly attracted to smoke. Smoke originating from different sources causes aggregation and swarming of these flies within smoke plumes.

In Western Australia, the genus *Microsania* is represented by *M. australis*, a small fly with a body length of 2.2 mm. *M. australis* is endemic to Australia and shows the remarkable attraction to bushfire smoke that is a characteristic of the genus.

The “smoke-fly” *Microsania australis* swarms in smoke-plumes

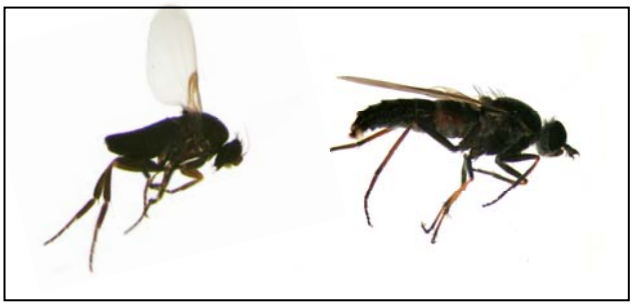
Findings

Two more fire-adapted fly species

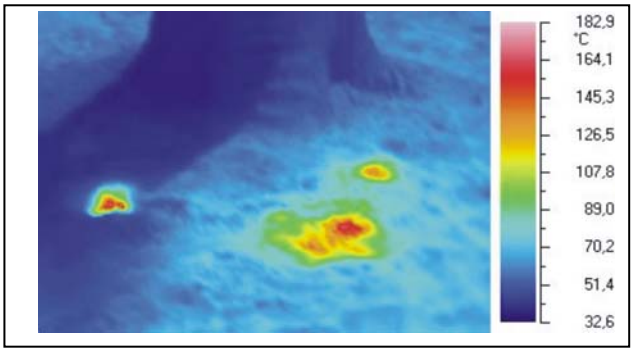
Freshly burned areas near Perth were investigated from 2006 to 2009. When the burned sites were visited, the running fire had been extinguished on the same day or up to five days before. Without exception, smoke from smouldering wood was present during observation and collecting of the flies.

Beside *M. australis*, two other fly species were observed showing pyrophilous behaviour; *Hypocerides nearcticus* (Phoridae) and *Anabarhynchus hyalipennis* (Therevidae). Pyrophilous behaviour has not been described before for the Therevidae or for the extremely large family of Phoridae.

H. nearcticus (2.0 mm body length) also aggregated in swarms on freshly burned sites. In contrast to *M. australis*, these swarms were not observed inside smoke plumes but occurred at a lower level, only a few centimetres above burned wood or soil where copulations were observed frequently.



Two more fire-adapted species: *H. nearcticus* (left) and *A. hyalipennis* (right)



Thermograph of a typical location of *A. hyalipennis* including hot spots in ash around a Eucalypt tree. Differences in temperature are indicated by colours

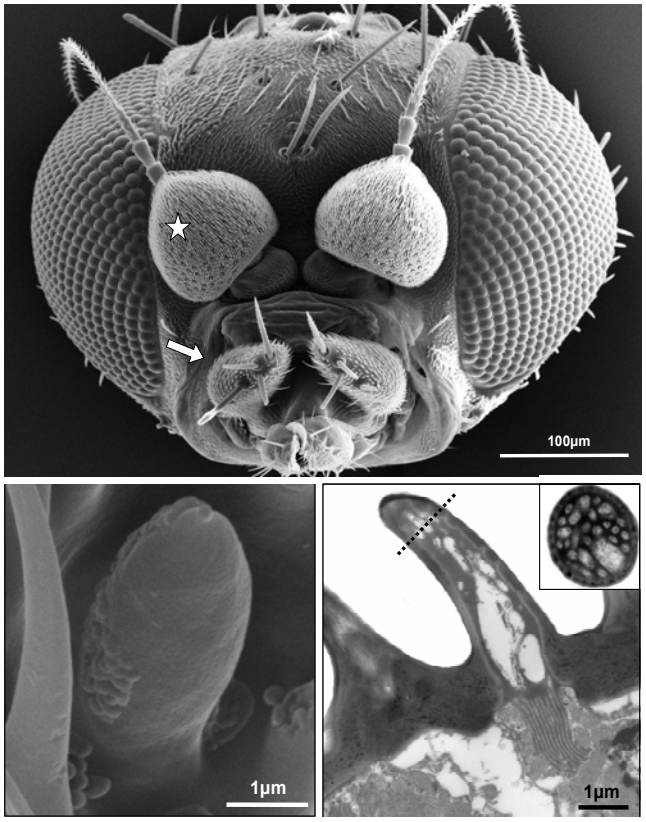
A. hyalipennis (~10 mm body length) was observed landing on ash-covered soil around burned logs. Afterwards these flies found shelter under leaves, dead branches or bark, and inserted their abdomen into the ash to deposit their eggs. Mostly, oviposition took place at logs where nearby hot spots (>80°C) were detected.

Assumed CO_2 – receptors on antennae and mouthparts

In order to determine the sensory equipment which enables the pyrophilous flies to detect bushfires from afar, the morphology of the sensory organs at the flies' heads were investigated. Transmission electron microscopy and scanning electron microscopy were used to reveal the outer appearance and inner ultrastructure of sensory organs.

Olfactory chemoreceptors were found on antennae and mouthparts that showed morphological features correlated with carbon dioxide reception. These receptors have sensory nerve cells that are strongly branched within the lumen of the receptor. As a consequence, in the distal part, the receptor's lumen is filled with densely packed branches of the innervating nerve cells. Such ultrastructural properties are commonly found in insect CO_2 receptors. Hence, it can be proposed that pyrophilous flies are able to sense CO_2 as an olfactory cue.

As bushfires release large amounts of CO_2, it may act as a marker substance which enables not only pyrophilous flies but also other fire-adapted insects to approach ongoing bushfires or freshly burned sites.



Above: SEM-image of the head of *H. nearcticus*. Antennae (asterisk) and mouthparts (arrow) are depicted

Left: Sensillum basiconicum on the antenna

Right: TEM-image of a longitudinal section through a S. basiconicum. Inserted: Cross-section of the distal part of the receptor. The lumen is filled by densely packed branches of sensory nerve cells

Management Implications

M. australis and *H. nearcticus* show an orientation towards burned wood and soil in order to lay eggs. It is assumed that the larvae of these flies feed on fire adapted fungi that develop fruit bodies immediately after a fire.

According to our observations on freshly burned areas revealing swarming, copulation and ovipositing of pyrophilous flies, it seems likely that these animals depend on the occurrence of fire for successful reproduction. The same is true for other fire-adapted insects like several species of buprestid beetles and flat bugs of the family Aradidae.

Freshly burned site in the Yanchep National Park

There is still much to learn about the ecology of pyrophilous insects. Doubtless, these insects will profit from numerous small burn or mosaic burning. Such fire regimes should enhance the probability of successful reproduction and ensure diversity of these fire adapted species.

Produced and published by the Science Division, Department of Environment and Conservation, Western Australia,
Locked Bag 104, Bentley Delivery Centre, WA 6983