Myiasis - lecture plan

- Introduction
- Defining myiasis
  - What is and what is not myiasis
  - Dermal and subdermal myiasis
  - Wound or traumatic myiasis
  - Accidental myiasis
- Evolution of parasitism
- Control and intervention strategies
  - Chemical control
  - Models of fly development
  - Climate mapping
  - Predictors of risk of fly strike, e.g. Strikewise
- Larval therapy
- Forensic entomology

Agents of myiasis

- Biology and life-histories of the main groups of myiasis flies
  - Calliphoridae
    - Blowflies
    - Screwworm flies
    - Bird blowflies
    - Calliphorids
  - Sarcophagidae
    - Sarcophagids
    - Wohlfahrtia sp.
  - Oestridae
    - Oestrids
    - Gasterophilids
    - Hypoderminids
    - Cuetrebrids
  - Others

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The importance of myiasis-causing flies

• As pests of livestock (and occasionally humans), i.e. as agents of myiasis
• As pests of wild animals
  – Myiasis-causing flies can significantly affect condition, fecundity, grazing behavior, and survival of wild animal populations
• As forensic indicators of time of death
• In medical applications - larval therapy

Defining myiasis

• Agents of myiasis include:
  – Bot and warble flies - Oestridae
  – Flesh flies - Sarcophagidae
  – Blowflies - Calliphoridae
  – Other Diptera - Muscidae, Syrphidae, etc.
• Infestation of a living animal by dipterous larvae
  (Hope, 1840; Zumpt, 1965)
### Classification of myiasis 1: according to the anatomical position in or on the host

<table>
<thead>
<tr>
<th>Category</th>
<th>Location</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutaneous</td>
<td>Skin surface</td>
<td></td>
</tr>
<tr>
<td>Intracutaneous</td>
<td>Subcutaneous tissue</td>
<td></td>
</tr>
<tr>
<td>Subcutaneous</td>
<td>Deep subcutaneous tissues</td>
<td></td>
</tr>
<tr>
<td>Perforating</td>
<td>Skin and muscle</td>
<td></td>
</tr>
<tr>
<td>Perforating-necrotic</td>
<td>Skin and muscle, causing tissue death</td>
<td></td>
</tr>
<tr>
<td>Perforating-tissue destruction</td>
<td>Skin and muscle, causing significant tissue damage</td>
<td></td>
</tr>
</tbody>
</table>

*Note: the division of myiasis into five rows is based on the grouping of Zumpt (1965) in the first column; the second and third columns show the comparable groupings of Bishop (see Patton, 1922) and the modification of these by James (1947). Re-drawn from Hall http://www.fao.org/DOCREP/U4220T/U4220T07.HTM*

### Classification of myiasis 2: according to the parasitic relationship of the Diptera with the host

<table>
<thead>
<tr>
<th>Category</th>
<th>Relationship</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>External</td>
<td>Eggs laid outside the host</td>
<td></td>
</tr>
<tr>
<td>Internal</td>
<td>Eggs laid inside the host</td>
<td></td>
</tr>
<tr>
<td>Intracuticular</td>
<td>Eggs laid beneath the skin</td>
<td></td>
</tr>
<tr>
<td>Perforating</td>
<td>Eggs laid in or beneath the skin, causing damage</td>
<td></td>
</tr>
<tr>
<td>Necrotic</td>
<td>Eggs laid in or beneath the skin, causing necrosis</td>
<td></td>
</tr>
</tbody>
</table>

*Sources: Patton (1922); Smart (1943); Zumpt (1965); Kettle (1984); Re-drawn from Hall: see http://www.fao.org/DOCREP/U4220T/U4220T07.HTM*

### Myiasis-causing flies

**Blowflies - Calliphoridae**

*Sources: Patton (1922); Smart (1943); Zumpt (1965); Kettle (1984); Re-drawn from Hall: see http://www.fao.org/DOCREP/U4220T/U4220T07.HTM*
Myiasis-causing flies: Lucilia bufonivora

Myiasis-causing flies: blowflies & screwworm flies

Blowflies and screwworm flies: economic impact

• Up to 80% of all British sheep farms have been documented as being affected by myiasis caused by the blowfly Lucilia sericata, with a mortality rate of around 2%
• In some other areas of Europe, mortality rates of up to 20-30% have also been reported
Typical blowfly lifecycle
One complete lifecycle of all stages of the parasite

Myiasis-causing flies: furuncular larvae

Myiasis-causing flies: sanguinivorous larvae

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Myiasis-causing flies
Flesh flies - Sarcophagidae

Myiasis-causing flies (2)
Flesh flies - Sarcophagidae

Myiasis
Bot and warble flies - Oestridae

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Vector-borne Diseases: Myiasis in Humans and Other Animals, Including Applied Applications in Larval Therapy & Forensic Entomology

Dr. Jamie Stevens

Oestridae warble fly - Hypoderma lineatum

Oestridae - various

Myiasis

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Evolution of parasitism in myiasis-causing flies


Evolution of myiasis

Contrasting breeding strategies can influence myiasis control strategies

Somerset, England
New South Wales, Australia
Myiasis control: traps, targets and insecticides

Myiasis control: docking, crotchting and mulesing

Control: disease ecology
• Strike, coupled with worm damage, notably dehydration and blood loss, can be particularly severe in young lambs
Vector-borne Diseases: Myiasis in Humans and Other Animals, Including Applied Applications in Larval Therapy & Forensic Entomology
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Distribution of New World screwworm fly
*Cochliomyia hominivorax*

- SIT relies on the widespread release of huge numbers of sterile males of the target pest species
- The sterile males then find and mate with fertile females in the field and the resulting egg batches are non-viable

Reproduced from *A Manual for the Diagnosis of Screw-worm Fly*, J.P. Spradbery, 1991, CSIRO, Canberra, Australia

Progressive shift of eradication zones in the screwworm SIT programme in North and Central America

1957 - 1959
1962
1966
1982 - 1985
1972 - 1981
1983
1996
1986 - 1991
1995
1999
1994
1998 - 2001
2001

Reproduced from Dr A. S. Robinson, FAO/IAEA, Vienna

Climate modelling to predict potential spread of Old World screwworm fly (*Chrysomya bezziana*) in Australia


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Climate data, models and control

- Temperate regions:
  Flies re-emerge in spring after winter diapause. Successive generations breed in discrete cohorts giving rise to cycles in fly numbers.

- Subtropical/tropical regions:
  No cold weather, no diapause; little fluctuation in fly numbers.


Larval therapy

- Reports of blowfly larvae cleansing wounds span many cultures over several centuries.

- The modes of action of 'wound-healing' larvae may be broadly categorized into three main areas:
  - Debridement
  - Disinfection
  - Stimulation of wound granulation and repair

Comparison of blowfly lifecycles

- The relatively well-defined succession of insects occurring on a dead body can be exploited to estimate a measure of time since death – often referred to as the minimum post mortem interval or simply 'minimum PMI'.
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- Dr James Wallman, School of Biological Sciences, University of Wollongong, Australia
- Dr Allen Robinson, FAO/IAEA, Wagramerstrasse, Vienna, Austria

Additional reading: general myiasis

- James, M.T. (1947) The flies that cause myiasis in man; US Dept Agric Misc Publ 631, Washington
- Sabrosky, C.W., G.F. Bennett and T.L. Whitworth (1989) Bird blow flies (Protocalliphora) in North America (Diptera: Calliphoridae), with notes on Palearctic species; Smithsonian, Washington
- Zumpt, F. (1965) Myiasis in Man and Animals in the Old World; Butterworths, London

Additional reading: control and intervention strategies


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Additional reading: evolution


Additional reading: larval therapy and forensic entomology


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