

A close-up photograph of a solitary bee, likely a mason bee, on a cluster of bright purple flowers. The bee is dark, fuzzy, and has its wings partially spread. It is positioned on the right side of the frame, facing left towards the flowers. The flowers are in sharp focus, showing their five-petaled structure and yellow centers. The background is a soft, out-of-focus blur of more purple flowers and green foliage.

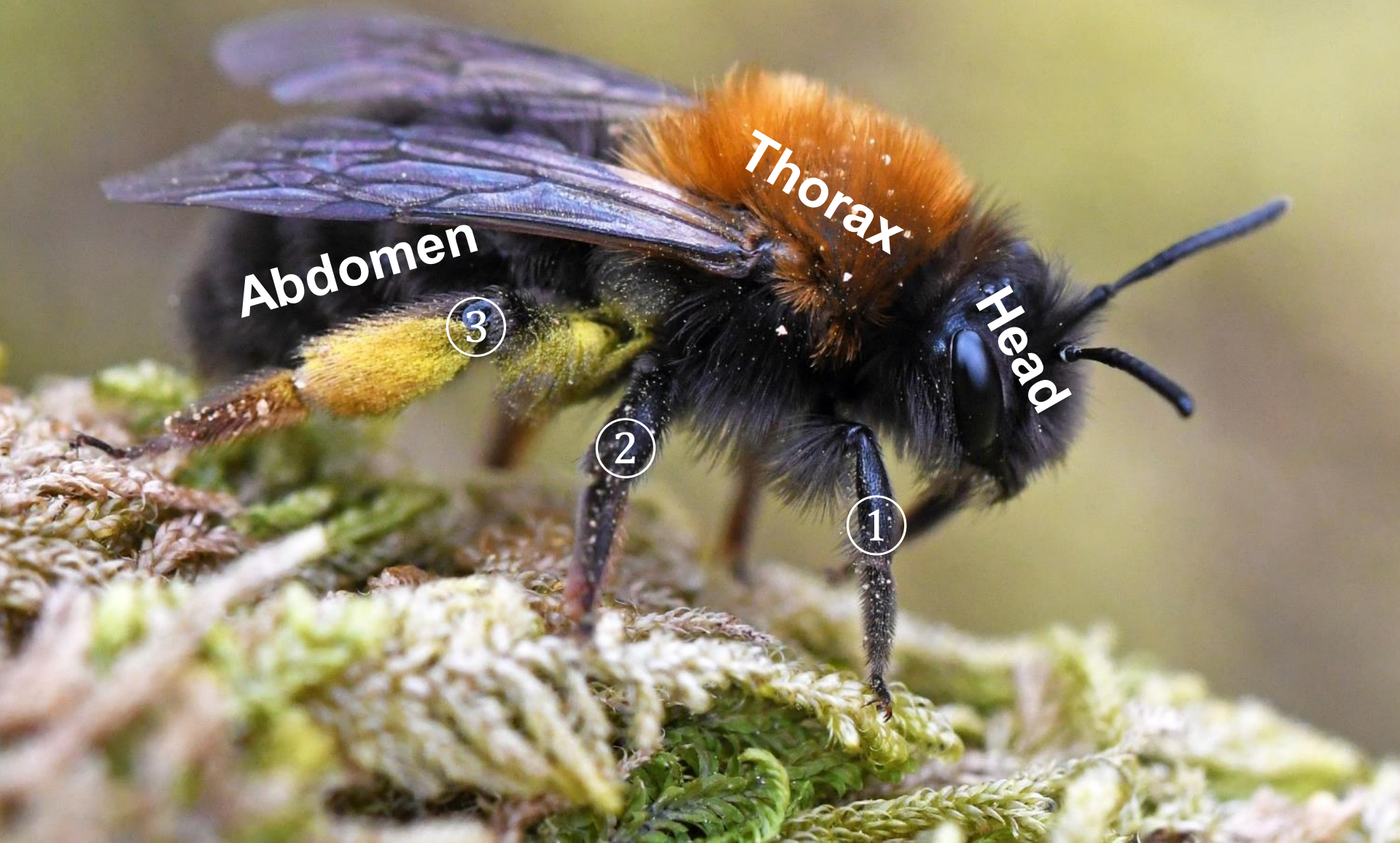
# Introduction to solitary bee genera

By Liam Olds

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# What is a bee?





**Order = Hymenoptera** (two pairs of membranous wings and an ovipositor specialised for stinging).



- **Superfamily = Apoidea** (bees).
- **Bees are actually crabronid wasps** – descendants of thrip-hunting wasps (sub-family Ammoplanina).
- **Evolved around 125 mya** – well before the mass extinction of the dinosaurs ~66 mya.
- **Over 20,000 species** – 5 x more than mammals, 3 x more than birds.





*“Electrostatically  
charged tool kit  
equipped for **gathering,**  
**manipulating and**  
**transporting** a diversity  
of **plant-derived**  
**products** for nest  
construction and larval  
provisioning”.*



# Bees in the UK

- Approx. 255 species of bee
  - 1 honeybee
  - 24 bumblebees
  - **230+ solitary bees!**
- All bees get **nectar** (fuel) and protein-rich **pollen** (for larval growth and egg production) from flowers.
- **Important pollinators** – especially solitary bees!





# Bees in the UK

**6 families > 27 extant genera > c. 255 species**

1. **Colletidae** – *Colletes* and *Hylaeus*.
2. **Andrenidae** – *Andrena* and *Panurgus*.
3. **Halictidae** – *Halictus*, *Lasioglossum*, *Sphecodes*, *Rophites* and *Duforea*.
4. **Melittidae** – *Melitta*, *Macropsis* and *Dasypoda*.
5. **Megachilidae** – *Anthidium*, *Stelis*, *Heriades*, *Chelostoma*, *Osmia*, *Hoplitis*, *Megachile* and *Coelioxys*.
6. **Apidae** – *Nomada*, *Epeolus*, *Eucera*, *Anthophora*, *Melecta*, *Ceratina*, *Xylopoca*, *Bombus* and *Apis*.

# Life-histories of bees

Three broad life-history strategies:

1. **Solitary** (Solitary and Communal)
2. **Social** (Eusocial and Cooperative breeding)
3. **Parasitic** (Brood parasite and Social parasite)





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# Solitary

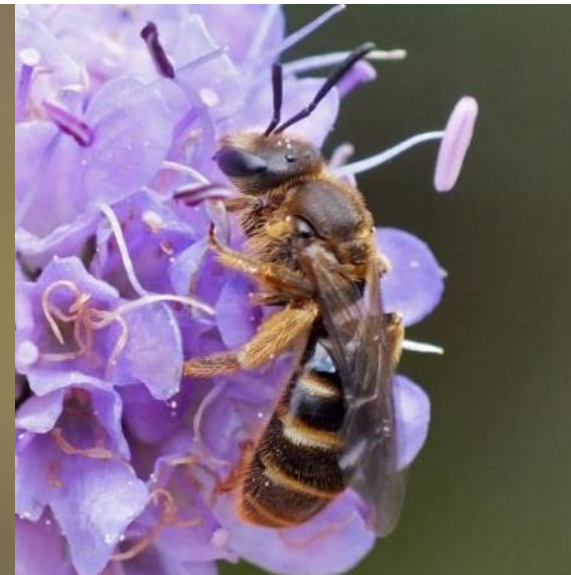
- Comprise the **majority of bees** worldwide (>75%).
- Females are like **hard-working single mothers**.
- Female solitary bees:
  - are all **capable of producing offspring**
  - **build and maintain their own nest**
  - **forage** for the floral resources necessary for provisioning their brood cells
- **Typically live alone** but some form *communal nests* where they share a nest entrance (but no cooperation among females).



# Life-histories of bees

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# Social

- Account for approximately **10% of all bee species**.
- Social bees exhibit 3 features:
  - **reproductive division of labour** meaning some females reproduce (“queens”), while others (“workers”) build and defend the nest and gather pollen and nectar for the developing offspring
  - **cooperative brood care** meaning females help rear offspring that are not their own
  - **overlap of generations** such that females are long-lived, and mothers and daughters occupy the same nest for an extended period of time.
- Reproductive division of labour = ***permanent*** in eusocial societies, ***temporary*** in cooperatively breeding taxa.



# Eusocial

- Eusociality is a **high-risk, high-reward investment strategy**.
- In ***primitively*** eusocial bees (bumblebees & some halictids):
  - queens and workers differ in body size (queens being larger)
  - nests are generally established by a single, foundress queen
  - nests usually last one season (i.e. are annual)
- In ***advanced*** eusocial taxa (honeybees & stingless bees):
  - queens and workers are morphologically distinct
  - nests are founded by a queen accompanied by a group of workers in a process called swarming
  - nests last longer than one year (i.e. are perennial)

# Life history – social vs. solitary

Life history trait	Social	Solitary
Generation per year	Always multivoltine	Usually univoltine
Period of adult activity	Long (several months)	Very short (sometimes weeks)
Host-plant specificity	Typically broadly polylectic	Broadly polylectic to narrowly oligolectic
Highest species richness	Humid tropics	Arid regions (deserts)

Source: Danforth, Minckley and Neff (2019)



# Life-histories of bees

Three broad life-history strategies:

1. **Solitary** (Solitary and Communal)
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3. **Parasitic** (Brood parasite and Social parasite)



¼ of UK  
species

- **Brood parasites** (cleptoparasites or cuckoo bees):
  - do not build their own nest or forage for pollen and nectar
  - enter the nests of free-living, pollen-collecting bees and lay an egg in a closed or open brood cell
  - adult female or her first-instar larva kills the host egg/larva, and cuckoo larva consumes the pollen and nectar provisions of the host.





- **Social parasites:**

- only attack social bee species
- social parasite enter the nest of a social host and effectively **replaces the resident queen** as the egg-laying female, while at the same time **enslaving the resident workforce** to rear her own offspring
- in some cases the host queen is killed, and in others she remains within the nest but ceases to lay eggs

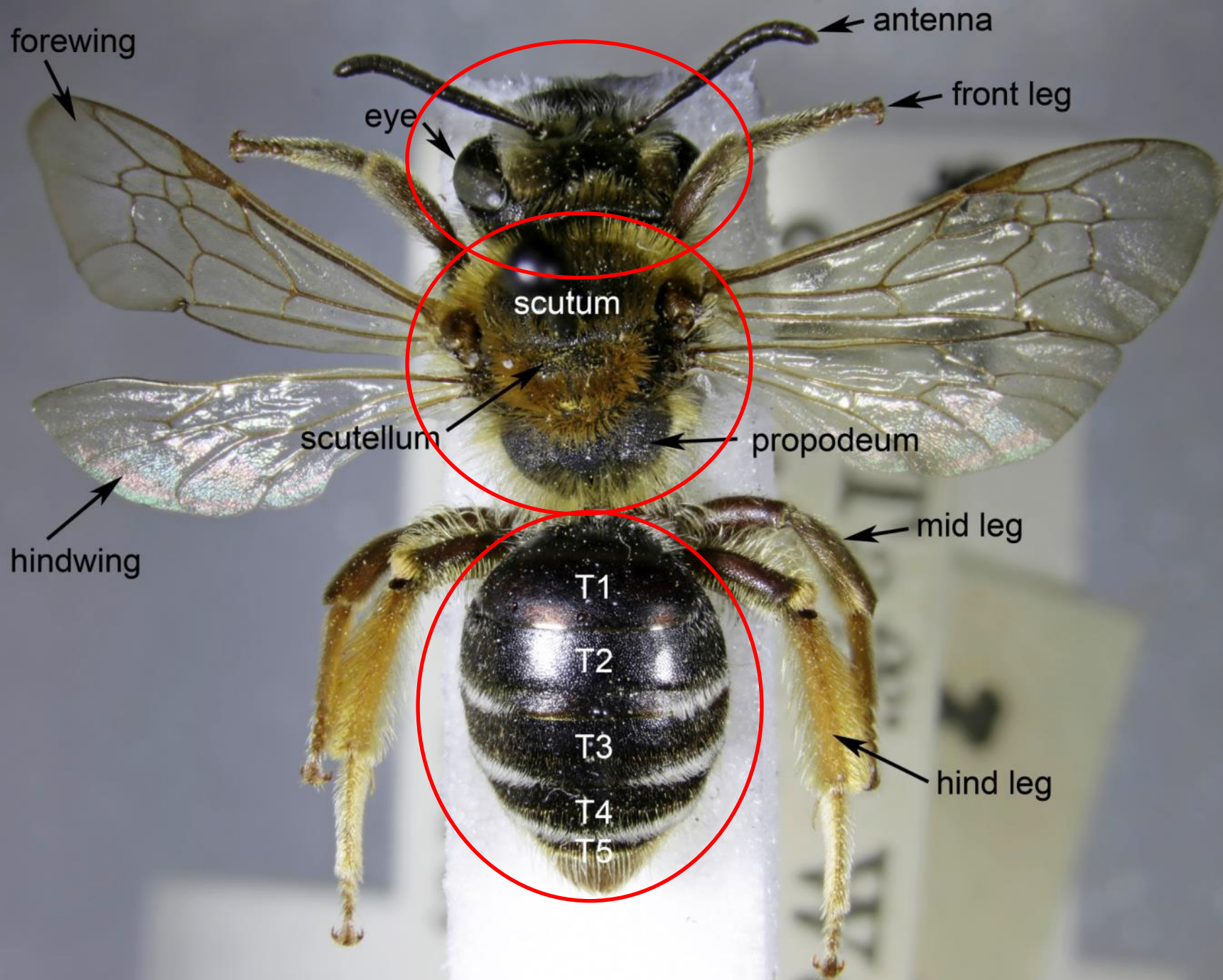




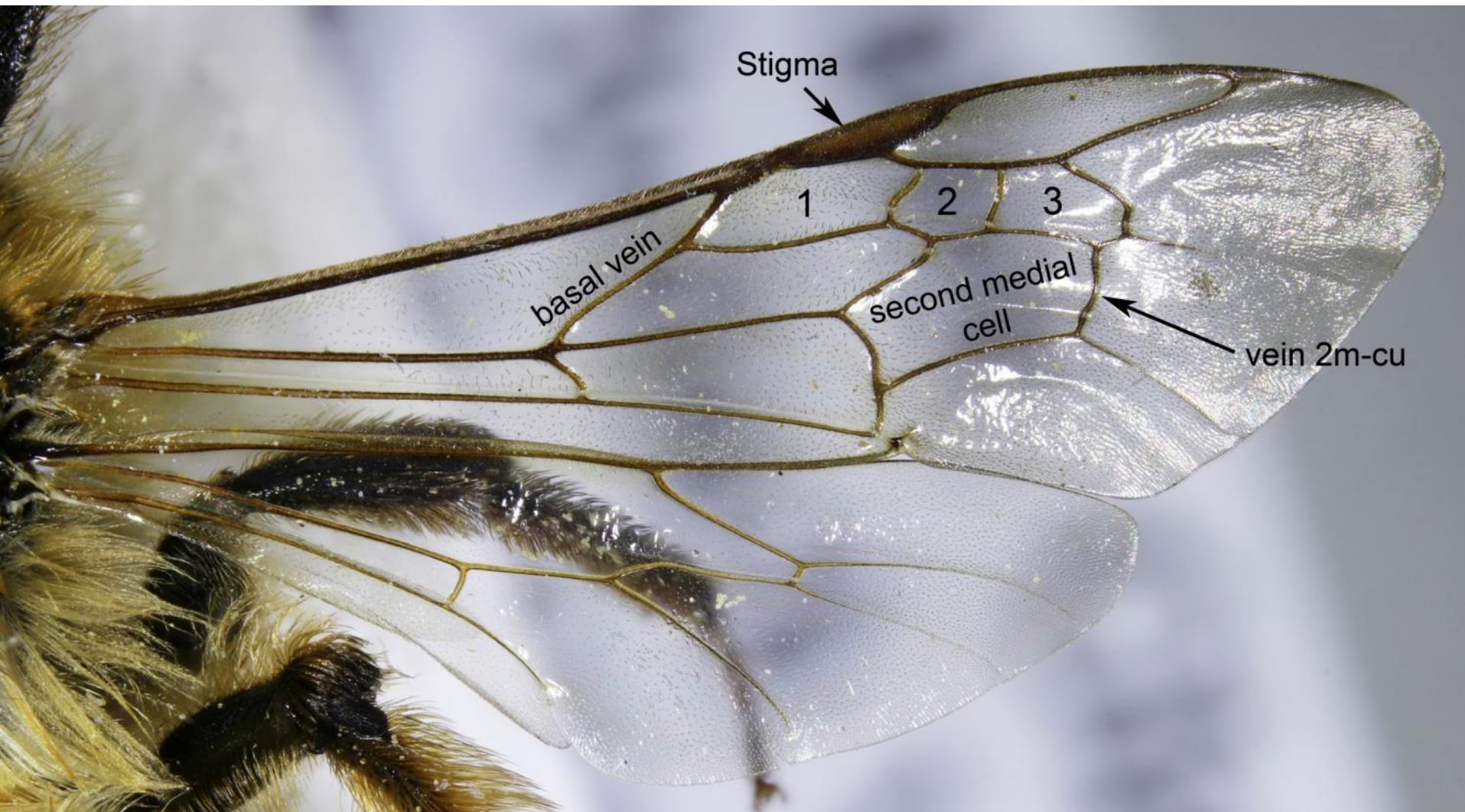
# Bee Identification







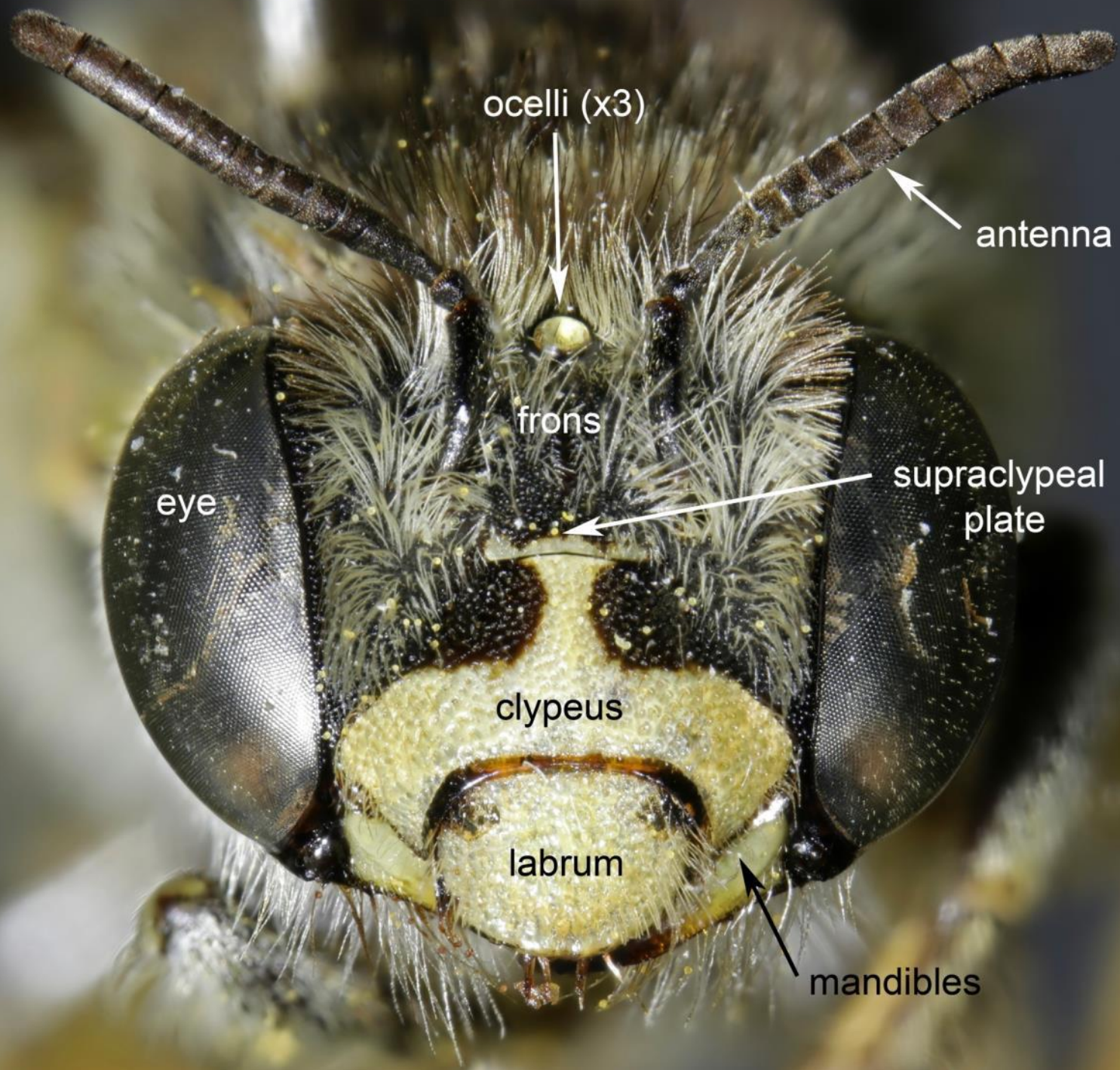




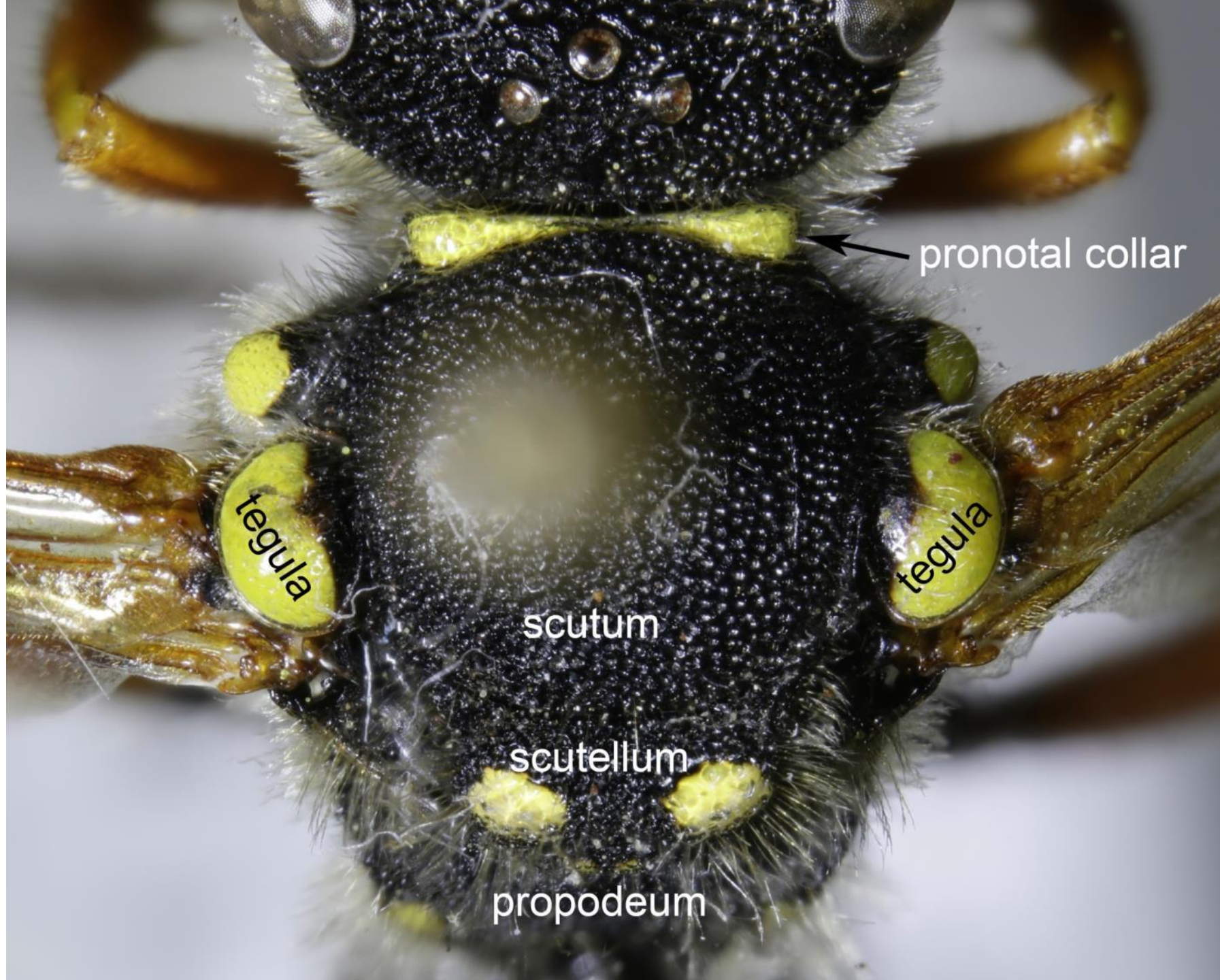




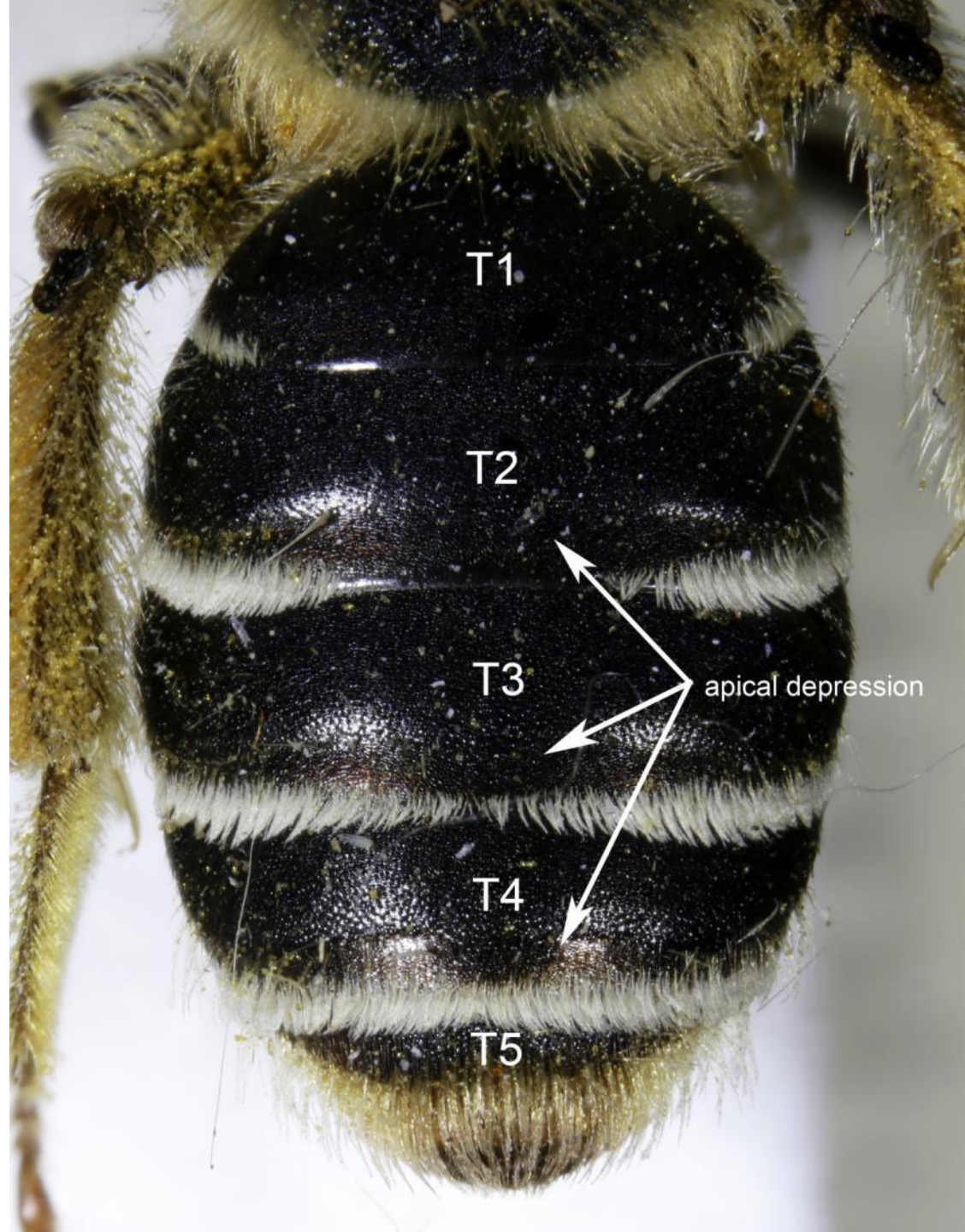




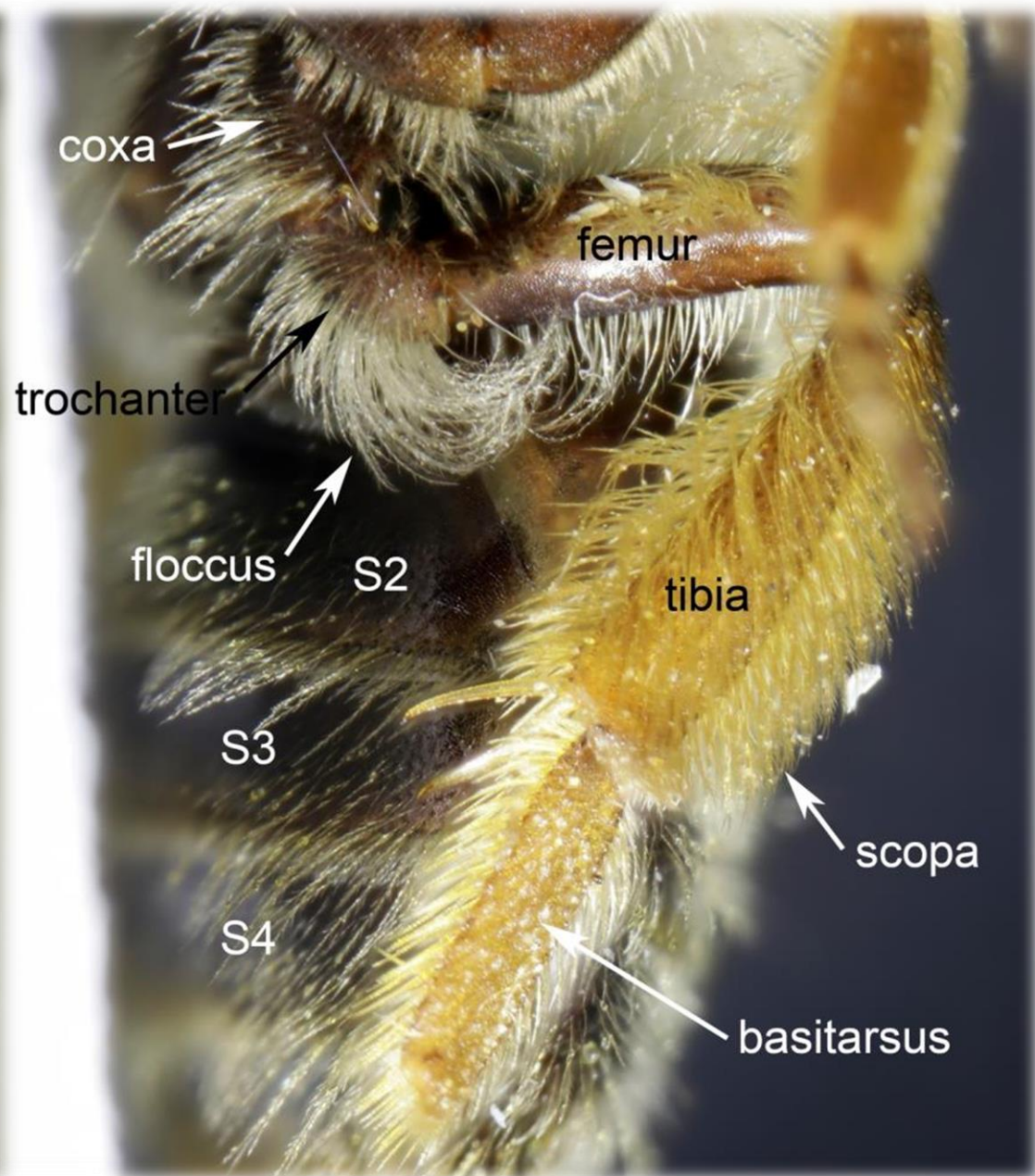
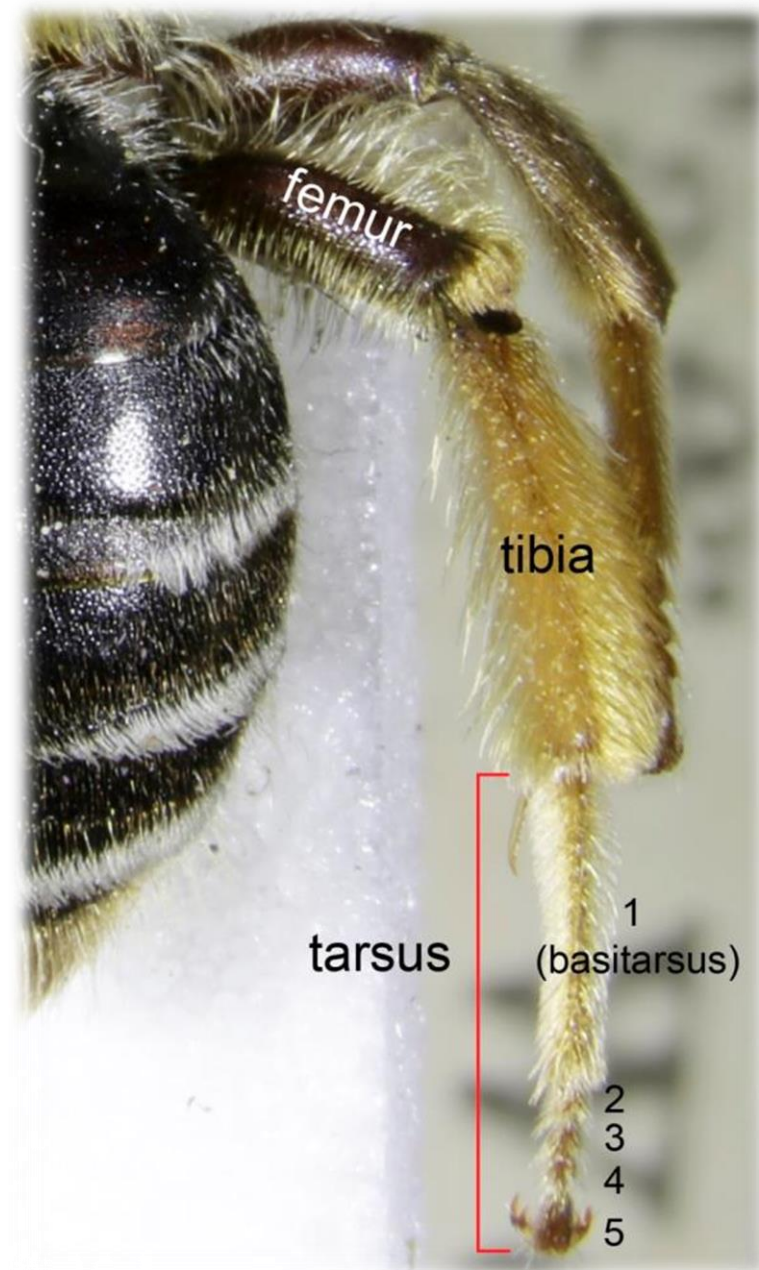




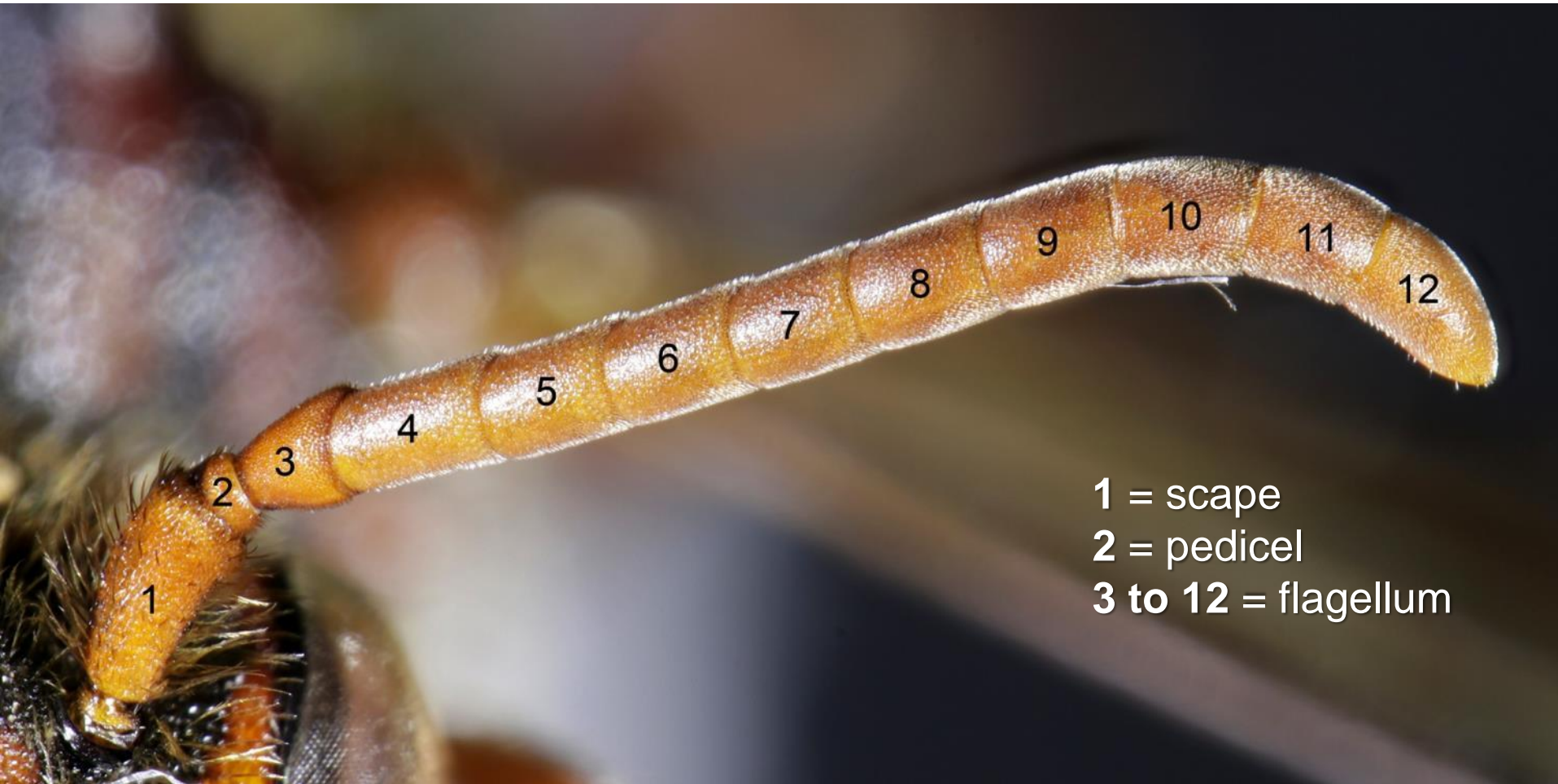








# Male or female?



1 = scape  
2 = pedicel  
3 to 12 = flagellum

12 antennal segments = **female** bees (+ male *Apis*)



# Male or female?



1 = scape  
2 = pedicel  
3 to 13 = flagellum

13 antennal segments = **male** bees



**Caution** – Pedicel can be partially or completely recessed into the end of the scape in male *Nomada*.

*Andrena fulva* female

© Steven Falk



- Antenna shorter with **12** segments.
- Abdomen usually with **6** visible tergites.
- **Densely haired pollen brush** present on hind legs or under the abdomen (except *Hylaeus* & in cuckoos).
- **Often larger, more robust and more colourful.**

*Andrena fulva* male

© Steven Falk



- Antenna longer with **13** segments.
- Abdomen usually with **7** visible tergites.
- No obvious pollen brush present.
- **Surface of face yellow or whitish** in certain genera or species.
- **Mandibles often slimmer or longer.**





- **Densely haired pollen brush** present on hind tibia\*
- Hind tibia typically **broader** and **outer surface convex**.

\* except *Hylaeus* and cleptoparasitic species



- **No obvious pollen brush** present on hind tibia – hairs sparse.
- Hind tibia typically **slimmer** and **outer surface straighter**.



pollen brush  
(scopa)

♀ *Megachile versicolor*









- **Pollen basket** present on hind legs\* – i.e. **flattish, shiny, hairless** outer face fringed with long hairs.
- Hind tibia typically **broader** and **outer surface convex**.

- **No pollen basket** present on hind legs – i.e. **less shiny** and **hairs present** on outer face.
- Hind tibia typically **slimmer** and outer surface **straighter**.

\* *Apis* and social *Bombus* only





# *Colletes* (Plasterer bees)

- All but one of British species have **banded abdomens**.
- Pollen collected on hind legs and propodeum.
- Typically summer active.
- Thick, **cellophane-like coating** applied to the brood cell using the brush-like, bifid glossa.
- Some are broadly polylectic, while other visit single family or even single species of plant (*halophilus* & *hederae*)
- Nesting occurs in light soil, sometimes forming large nesting aggregations.





Bands of flattened,  
scale-like hairs





Female *Colletes hederae*



*Colletes* forewing showing 'S-shaped' vein 2m-cu





Male *Colletes hederæ*





Female *Colletes succinctus*





Male *Colletes succinctus*





Female *Colletes cunicularius*





Male *Colletes cunicularius*



Female *Colletes* can be identified to species by looking at the punctures and hairs on tergite 1.









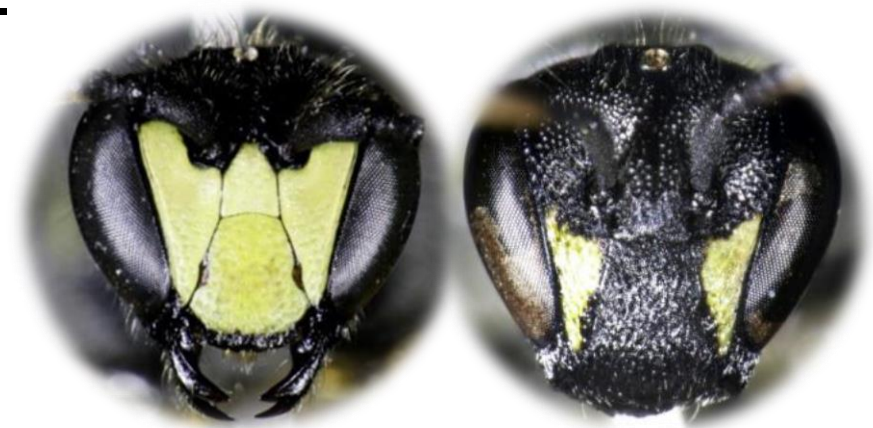






# *Hylaeus* (Yellow-face bees)

- **Small, black, inconspicuously haired** bees that **lack pollen brushes**.
- Unusually for bees, **pollen is carried in the crop** and regurgitated back at the nest.
- **Females** usually have a **pair of yellow/white spots** on the face.
- **Males** usually have the **face predominately white/yellow**.
- Nesting occurs in hollow plant stems and pre-existing holes in wood, walls and vertical earth banks.





Female *Hylaeus* can be identified to species by looking at the positioning of facial markings.







Male *Hylaeus* can be identified to species using many of the same characters, as well as shape/colour of antennal scapes.







Long facial hairs are distinctive  
for male *Hylaeus hyalinatus*.





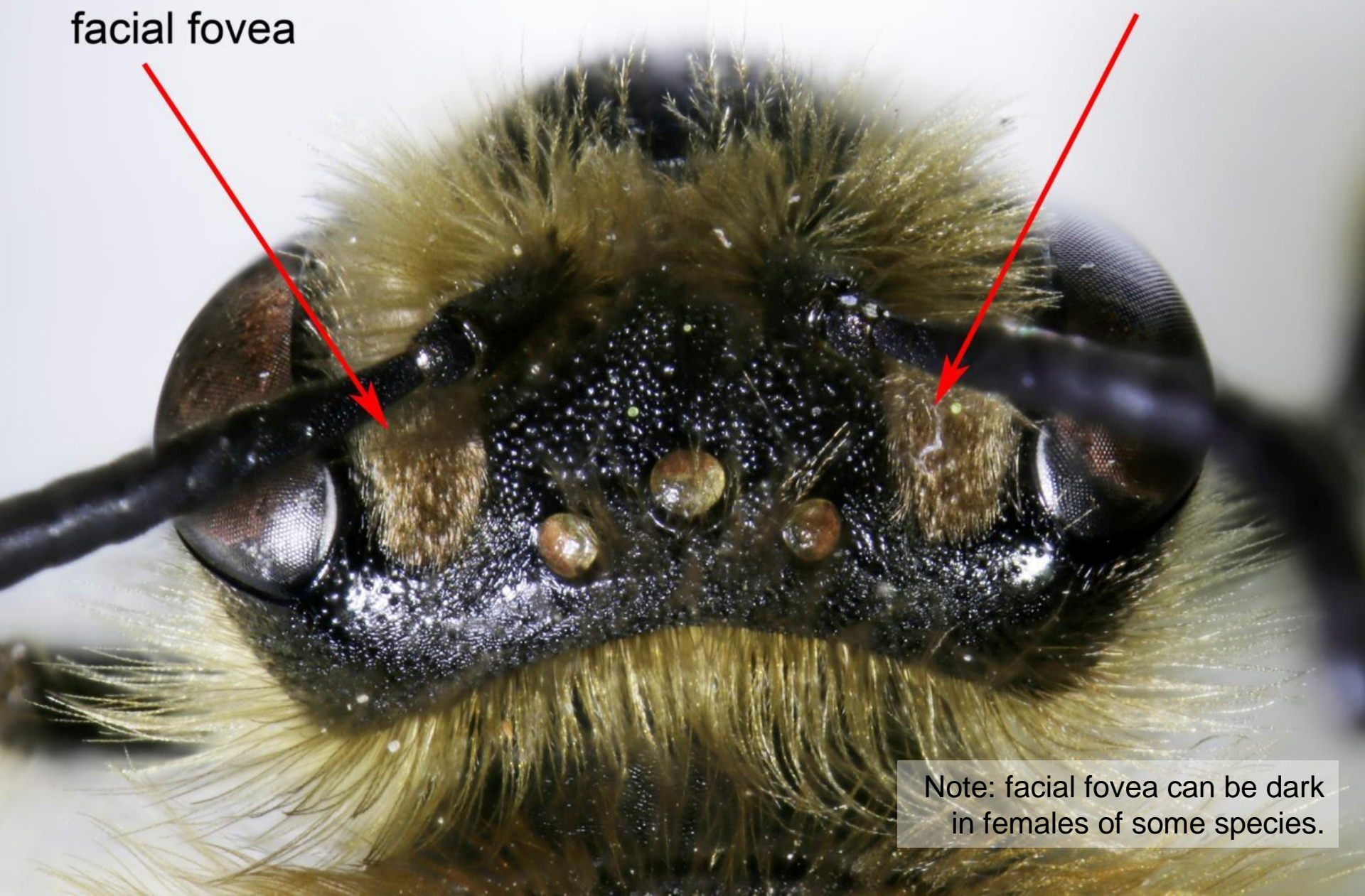
# *Andrena* (Mining bees)

- Largest bee genera in Britain!
- Most easily separated from similar genera by **facial foveae** (strips of velvety hair alongside inner eye margins) – females only!
- Facial foveae may play a role in **intra-nest communication**.
- Pollen collected on hind legs and propodeum.
- Majority of species are **univoltine**, with flight periods ranging from early spring to late summer depending on species.
- Most provision **less than 1 brood cell per day** and produce **less than 10 offspring** over their entire lives.



facial fovea

facial fovea



Note: facial fovea can be dark in females of some species.





Hair colour on face, top of thorax, abdomen and pollen brush (scopa) are useful clues to identify female *Andrena* species.





Female *Andrena fulva*





Mating pair of *Andrena cineraria*





Female *Andrena flavipes*





Female *Andrena ovatula*









Female *Andrena rosae*





Female *Andrena nitida*





Male *Andrena* identification relies on face colour (surface), hair colour on face, size/shape of projection at base of mandibles, and the length of antennal segments.

Male *Andrena coitana*



Male *Andrena praecox*



A few examples of females and males of the same species.



Female *Andrena barbilabris*





Male *Andrena barbilabris*





Female *Andrena* cf. *minutula*





Male *Andrena* cf. *minutula*





Female *Andrena haemorrhoa*





Male *Andrena haemorrhoa*





Female *Andrena clarkella*





Male *Andrena clarkella*





# *Panurgus* (Shaggy bees)

- **Black, shiny** and sparsely haired bees with **conspicuous yellow pollen brushes** on the female hind legs.
- Pollen gathered predominantly from **yellow-flowered Asteraceae**.
- Nesting occurs in light soil, often in aggregations. Coastal in Wales.





# *Halictus* (End-banded furrow bees)

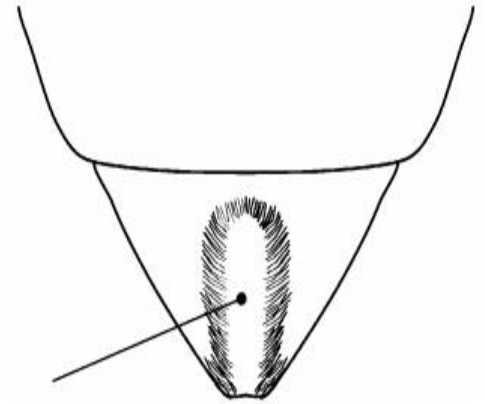
- **Only 2 species are common and widespread** in Britain.
- Pollen collected on hind legs.
- End of abdomen (T5) with a bare-looking median 'furrow' (**rima**).
- Any pale hairs on the tergites are along the **apical margins** (end).
- Many species form large nesting aggregations.
- Includes **solitary** and **primitively eusocial species**.







T5 with rima



'rima' = furrow  
running down  
centre of T5 in  
*Lasioglossum*  
and *Halictus*  
females






Female *Halictus tumulorum*





Female *Halictus rubicundus*



A close-up photograph of a male furrow bee, specifically a male *Halictus rubicundus*, resting on a bed of dry, brownish soil and organic debris. The bee has a black head and thorax, with a yellowish-brown fuzzy covering on its neck and legs. Its wings are transparent with a distinct reddish-brown or pinkish tint. The most prominent feature is its exceptionally long, dark antennae, which are extended forward. The background is a textured surface of dry leaves, twigs, and small stones.

Male furrow bees (*Halictus* and *Lasioglossum*) can have noticeably long antennae (more so than *Andrena* males) and yellow markings on legs.

Male *Halictus rubicundus*





# *Lasioglossum*

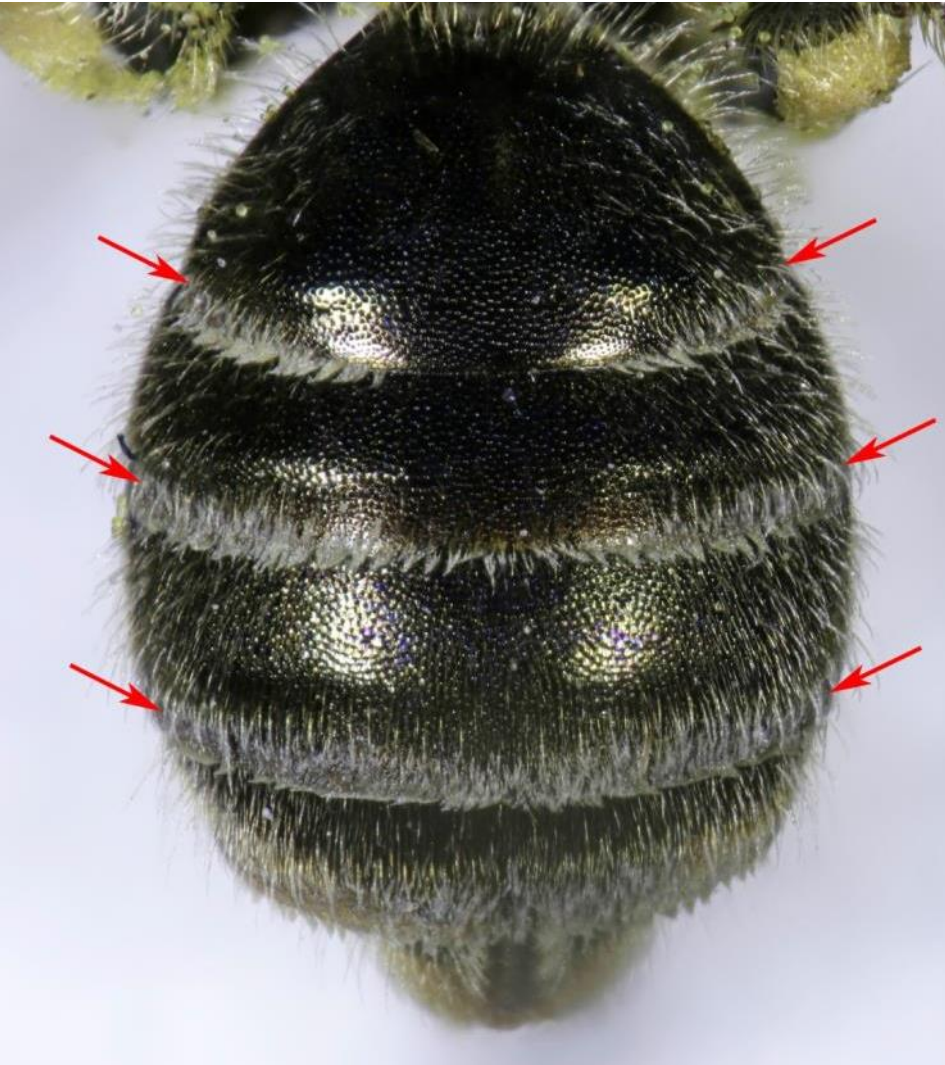
## (Base-banded furrow bees)

- **33 extant species in the UK**, with two known only from Channel Islands.
- Pollen collected on hind legs.
- End of abdomen (T5) with a bare-looking median 'furrow' (**rima**).
- Any pale hairs on the tergites are usually located **only at the base**.
- Many species form large nesting aggregations.
- Includes **solitary** and **primitively eusocial species**.



# Separating *Halictus* and *Lasioglossum*

the apical margin (i.e. end) – **red arrows**  
= ***Halictus*** End-banded furrow bees  
(7 species)



the basal only – **black arrows**  
= ***Lasioglossum*** Base-banded furrow bees  
(33 species)







Outer cross  
veins of **similar  
thickness** and  
colour to other  
wing veins =  
***Halictus***



Outer cross  
veins **thinner**  
and often paler  
than other wing  
veins =  
***Lasioglossum***



Female *Lasioglossum* cf. *zonulum*





Male *Lasioglossum* cf. *zonulum*





Female *Lasioglossum* cf. *morio*





Female *Lasioglossum calceatum*





# *Sphecodes* (Blood bees)

- **Mostly hairless** with a **red and black abdomen**; females have no pollen brush.
- Brood-parasites of various ground-nesting bees of the genera *Andrena*, *Lasioglossum* and *Halictus*.
- Females are usually most evident around host nesting areas; males on flowers.
- Males appear considerably later than females, peaking in late summer.



**Can use chemical warfare** – some use pheromones to disorientate their hosts when in communal or eusocial nests.





Female *Sphecodes*





Female *Sphecodes monilicornis*



# Lookalikes

© Jeremy Early



*Andrena labiata*



*Andrena rosae*



Some *Lasioglossum* males (*abipes* & *calceatum*)





# *Melitta* (Blunthorn bees)

- **Narrow foraging preferences.**
- Best found by observing known forage plants in suitable weather.
- Adults fly from mid- to late summer.
- Superficially resemble some *Andrena* but: have **blunt tips to the antennae**, lack the facial foveae, and the **final segment of the tarsi is larger**.
- Pollen is never collected on the hind femora or sides of propodeum as seen in *Andrena*.





antenna with tips **pointed**  
= ***Andrena***  
Mining bees



antenna with tips **blunt**  
= ***Melitta***  
Blunthorn bees





last segment of tarsi **long**  
**and slim** = *Andrena*

relatively short and **broader**  
= *Melitta*





Family = Melittidae

# Clover Mellita bee (*Mellita leporina*)



Female © Steven Falk



Male © Steven Falk



# *Macropsis*

## (Oil-collecting bees)

- Pollen and floral oils collected from **Yellow Loosestrife** (*Lysimachia vulgaris*).
- As nesting sites are at risk of flooding, nests are waterproofed using oils from the main forage plant.
- **Wetland species.**
- Females have a large pollen brush that is **white-haired on the tibia** and **black-haired on the basitarsi**.
- Males have hind femora and tibia swollen, and have a bright yellow face.



© Steven Falk





# *Dasypoda* (Pantaloön bees)

- **Single UK species (*D. hirtipes*).**
- Females have large, **pantaloön-like pollen brushes** on the hind legs; males have unusually long hairs on the hind legs.
- **Strongly associated with yellow composites** (Asteraceae) such as Cat's-ear, hawk's-beards, ragwort, Common Fleabane etc.
- **Nests in sandy ground.**
- Do not line their brood cells – an adaptation to dry environments?





Female *Dasypoda hirtipes*





# *Anthidium* (Wool carders)

- **Single UK species.**
- Robustly built bees with a **pattern of yellow spots** on the tergites.
- Females have a pollen brush beneath the abdomen.
- Serrated, comb-like mandibular teeth for **scraping fibres** from the leaves and stems of furry or woolly plants (particularly Lamb's-ear).
- Particularly **frequent in gardens.**
- Males are **highly territorial.**





Male *Anthidium manicatum*





Male *Anthidium manicatum*



## *Stelis* (Dark bees)

- **Strongly punctate, inconspicuously haired and mainly black.**
- Males and females look similar.
- **Brood parasites** of other megachilids including *Anthidium*, *Heriades*, *Hoplitis* and *Osmia*.
- Best found by searching for females close to host nesting areas.





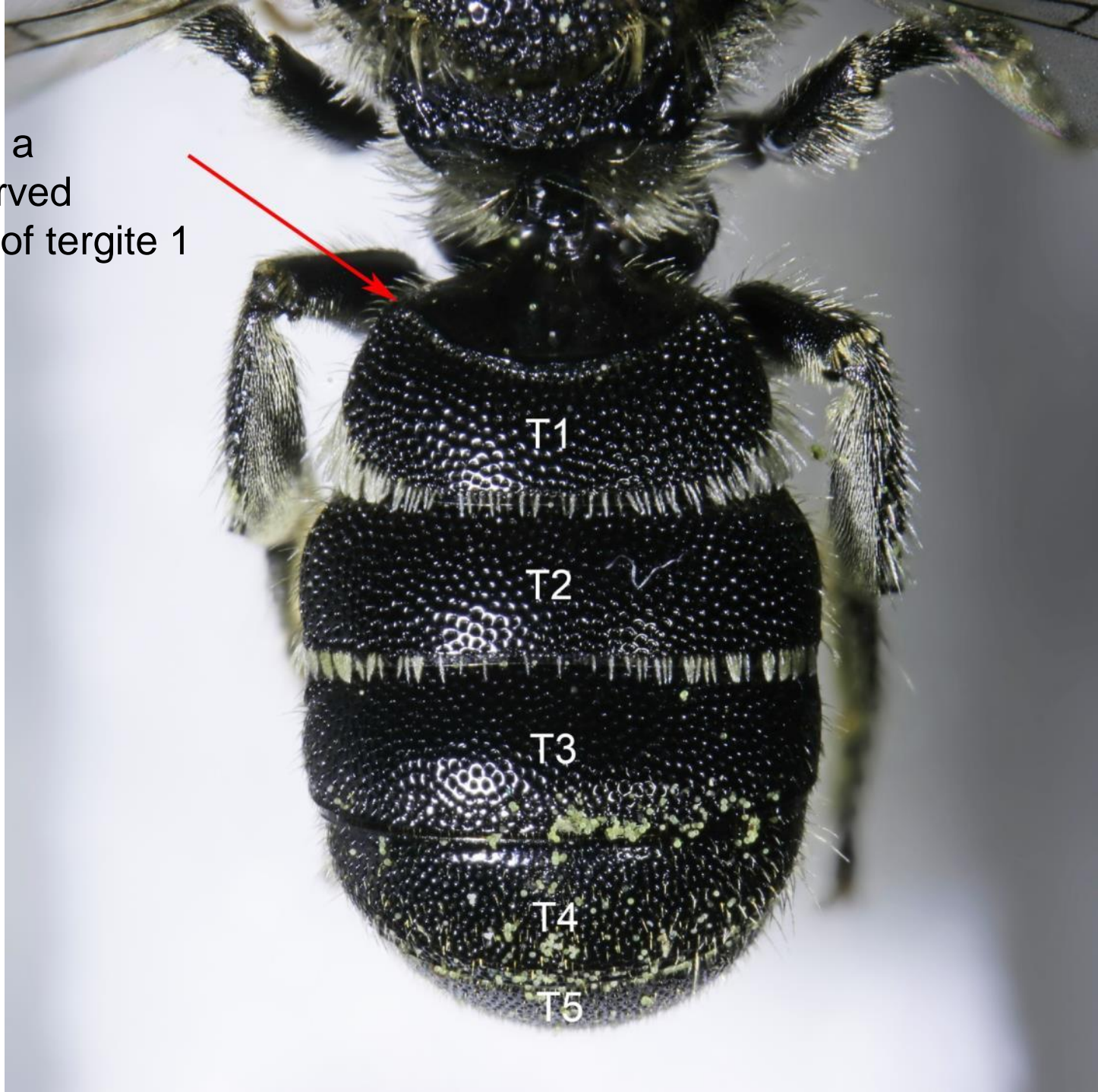


# *Heriades* (Resin bees)

- One resident species (*truncorum*).
- Small, blackish, coarsely punctate, inconspicuously haired.
- Females have a pollen brush beneath the abdomen.
- Have characteristic **curved ridge across top of tergite 1**.
- Nest in deadwood and hollow plant stems **using resins** (from trees such as conifers) **to construct cells**.
- **Strongly associated with yellow composites**, especially ragworts.



Both sexes have a  
characteristic curved  
ridge across top of tergite 1  
(red arrow)







Female *Heriades truncorum*





# *Chelostoma* (Scissor bees)

- **Slender bees.**
- Females have a pollen brush beneath the abdomen.
- **Oliglectic** – *Campanula* bell-flowers for *C. campanularum*, and buttercups for *C. florisomne*.
- **Nesting occurs in pre-existing cavities** (especially beetle holes in wood).



*Chelostoma florisomne* © Steven Falk





Male *Chelostoma florisomne*



# *Osmia* (Mason bees)

- **Often with colourful body hairs** and sometimes metallic integument.
- Females have a pollen brush beneath the abdomen.
- Some have **large, box-shaped heads and powerful jaws.**
- **Aerial nesters** in pre-existing cavities but **also empty snail shells.**
- Most species are distinctive.







Colour of body, body hairs and pollen brush useful for identification in females, plus presence/absence of horns.

Body colour, eye colour and other characters useful in male identification.

Female *Osmia caerulescens*





Female *Osmia bicornis*





Male *Osmia bicornis*





Female *Osmia aurulenta*





Male *Osmia aurulenta*





Female *Osmia spinulosa*





Male *Osmia spinulosa*





Female *Osmia bicolor*





# *Hoplitis*

## (Lesser mason bees)

- **Just 1 extant species.**
- **Small** and **closely related to *Osmia*** with a similar range of nesting habits and foraging behaviour.
- **Parapsidal lines** on scutum (above wing cases) longer than all *Osmia* (except *O. spinulosa*).
- Females have a **cream-coloured pollen brush** beneath the abdomen (black or orange-haired in *Osmia*).






# *Megachile* (Leafcutter bees)

- Females of many species **cut out sections of leaf** and carry these back to the nest in their jaws.
- British species include aerial nesters and several ground-nesters associated with sandy habitats (e.g. *leachella* and *maritima*).
- Males of some species have **expanded front tarsi**.
- Females have pollen brush underneath the abdomen.
- Typically brown-haired and lack the colourful surface body/hairs of *Osmia*.







Female identification relies heavily on the presence/absence of long erect/semi-erect hairs on the dorsal surface of Tergite 6, as well as the colour of the pollen brush (especially at tip).

Female *Megachile centuncularis*





Female *Megachile leachella*






Female *Megachile leachella*





Female *Megachile willughbiella*





Male identification relies on front tarsi (modified or not), shape of notch on Tergite 6, as well as other characters.

Male *Megachile willughbiella*





Male *Megachile ligniseca* © Steven Falk





Male *Megachile leachella*





# *Coelioxys*

## (Sharp-tailed bees)

- Unusual in having **hairy eyes** (*Apis* is the only other).
- **Pointed abdomen in female**; male abdomen is blunter and bears several spines.
- Densely punctate with **conspicuous patches of dense adpressed white hairs** on tergites and sternites.
- **Brood parasites** of *Megachile* and *Anthophora* species.
- Surprisingly elusive and best found close to host nesting areas.







Female identification relies heavily on the shape of sternite 6 (and whether teeth are present), hair bands on tergites, and punctures on sternites.

Female *Coelioxys mandibularis*





Male identification relies on the tergite 5 (and whether teeth are present), hair bands on tergites, and genitalia.

Male *Coelioxys conoidea*

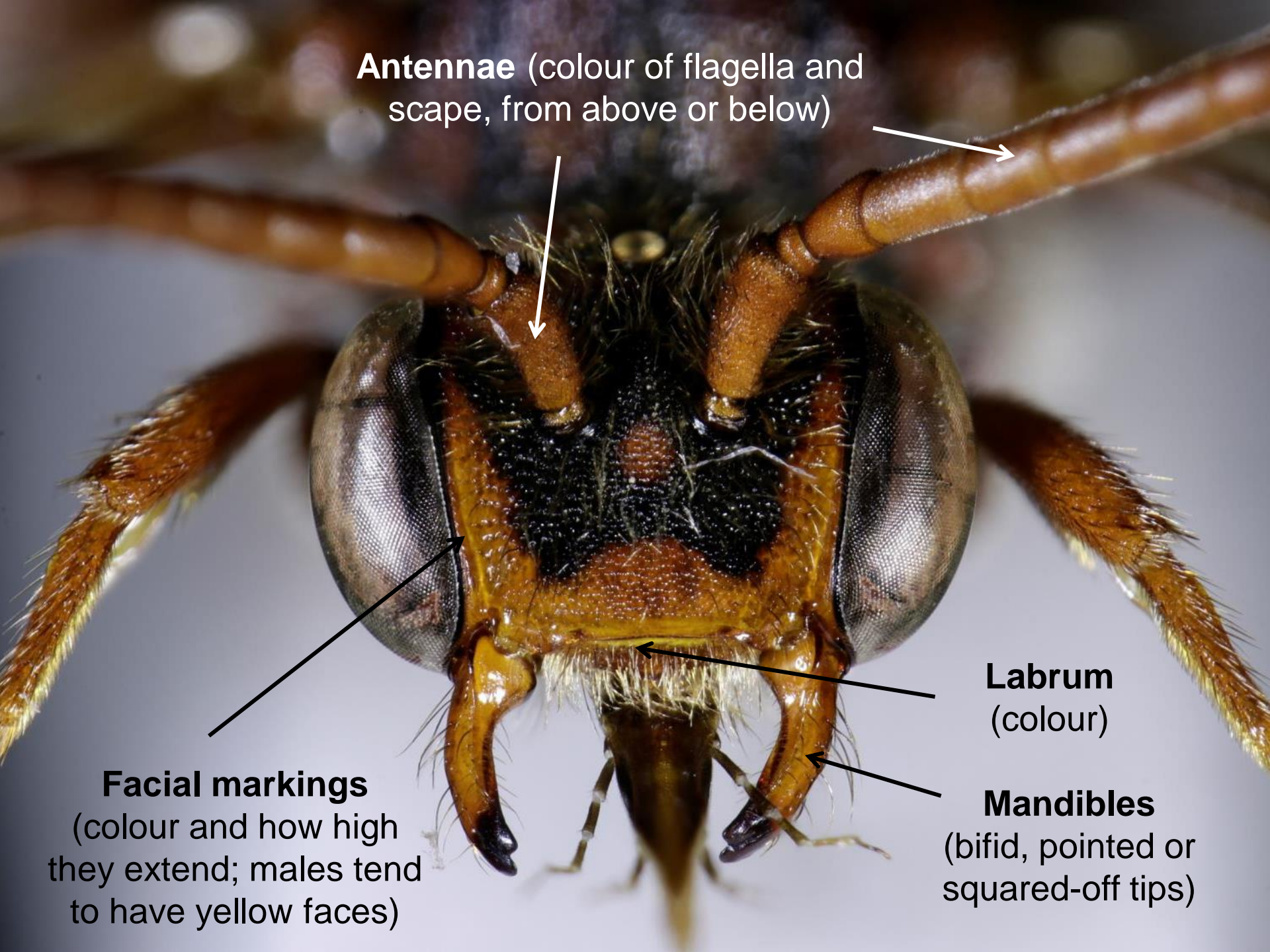




# *Nomada* (Nomad bees)

- Relatively hairless bees, often with **bold wasp-like markings**.
- **Brood parasites**, primarily of *Andrena* species but also *Melitta*, *Lasioglossum*, *Panurgus* and *Eucera*.
- Females are able to detect nests that are still being provisioned.
- **Spring is best time** to see a good variety of species, but several late-summer species exist.
- Females are useful in revealing the location of host nests.





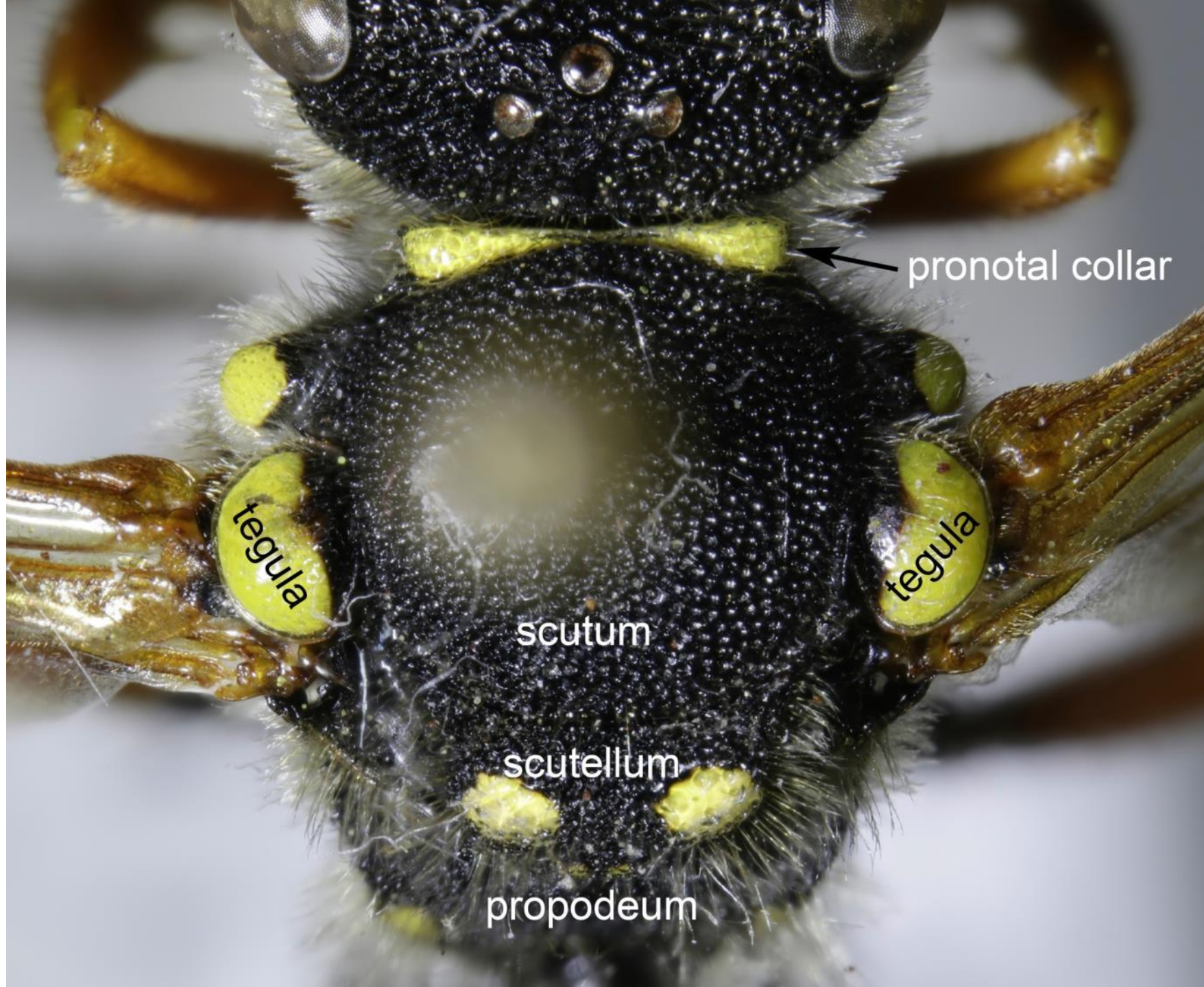
**Antennae** (colour of flagella and  
scape, from above or below)

**Labrum**  
(colour)

**Mandibles**  
(bifid, pointed or  
squared-off tips)

**Facial markings**  
(colour and how high  
they extend; males tend  
to have yellow faces)





pronotal collar

tegula

scutum

tegula

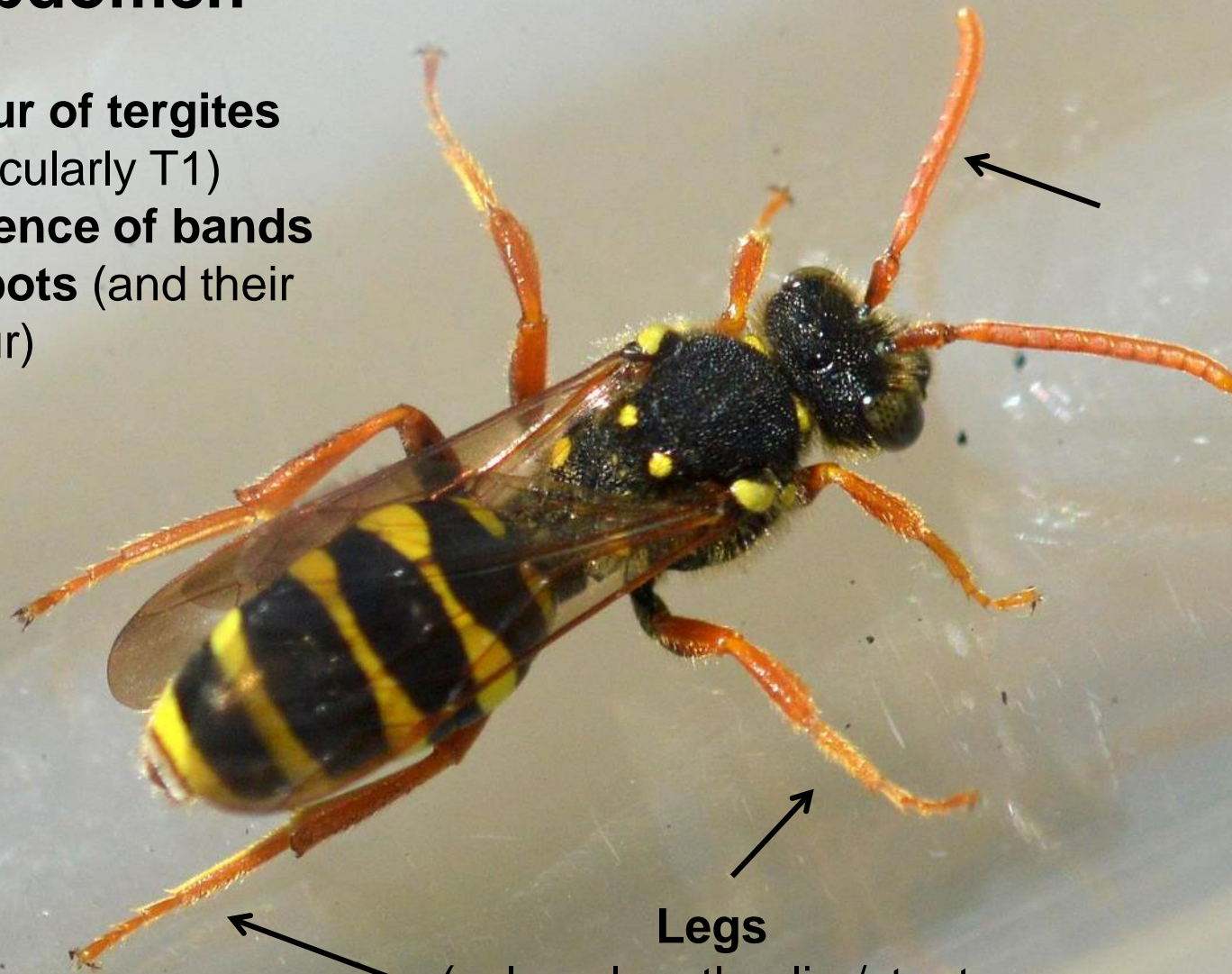
scutellum

propodeum



# Abdomen

- **colour of tergites**  
(particularly T1)
- **presence of bands or spots** (and their colour)



## Legs

(colour, length, slim/stout, tarsi width, comb spines)





Female *Nomada fabriciana*





Female *Nomada flava/panzeri/ruficornis*





Female *Nomada flavoguttata*





Female *Nomada fucata*





Female *Nomada goodeniana*





*Nomada rufipes*





Female *Nomada leucophthalma*





Female *Nomada lathburiana*





# *Epeolus*

## (Variegated cuckoo bees)

- Relatively hairless, **brightly patterned** and **stockily built**.
- **Brood parasites** of *Colletes* bees.
- **Scutellum black in males** (red or partially red in females).
- DNA analysis may reveal additional species in Britain.
- Specimens needed for reliable species-level identification (examination of genitalia in males).







Female *Epeodes cruciger/variegatus*





# *Eucera*

## (Long-horned bees)

- **Males have long antennae** and yellow faces.
- Females are larger, stockier, have shorter antennae and can resemble *Anthophora* (but have **two** rather than three **submarginal cells**).
- Strongly associated with legumes.
- Males can be important pollinators of *Ophrys* orchids (e.g. Bee Orchid).
- Much declined.







Mating pair of *Eucera longicornis*





# *Anthophora* (Flower bees)

- **Robustly built, hairy bees** that sometimes exhibit strong sexual dimorphism.
- **Superficially resemble bumblebees** but flight is much stronger, faster and they tend to hover near flowers.
- Males usually have a partially yellow or white face; some also have legs modified by hairs and armature.
- Most nest in the ground or use cliffs and walls, some prefer to nest in deadwood or hollow stems.
- Banding and hair colour useful for identification, plus male face colour.







Female *Anthophora plumipes*





Male *Anthophora plumipes*





Male *Anthophora furcata*



# *Melecta* (Mourning bees)

- One extant species.
- **Mostly black with grey/white hair bands or spots and a rather pointed abdomen.**
- Fully black individuals are not uncommon.
- **Brood parasites** of *Anthophora* bees.







# *Ceratina*

## (Small carpenter bees)

- **Small, slim, metallic blue bee** superficially resembling some metallic *Lasioglossum* species but with a different body shape.
- Males have lower clypeus and labrum cream-coloured.
- **Nesting occurs in hollow twigs and stems** (such as brambles and roses) **close to the ground**.
- Females of other *Ceratina* species are known to guard offspring until adulthood.







# *Xylocopa*

## (Large carpenter bees)

- **Large, shiny black, robust bee with long dark wings that have blue and violet reflections.**
- Considered a vagrant or human-assisted introduction – little evidence of a true, permanent population.
- **Nesting occurs in deadwood, structural timbers, hollow stems and other cavities.**
- Large, powerful jaws enable females to excavate tunnels into wood or pith.

