

- ▲ **Clouded Silver** *Lomographa temerata*. Silky white wings with a greater or lesser amount of dark grey shading readily distinguish this species, although clouding may be absent in some females. 5-6 in woods and hedgerows. Larva, green with reddish spots, feeds on blackthorn and several other trees and shrubs. C.
- ▲ **White Pinion-spotted** *L. bimaculata* has silky white wings like Clouded Silver, but black spots on front edge of forewing readily distinguish it. 4-6 in woods and scrubby places. Larva is dark green with purplish arrowhead marks on the back. It feeds on wild cherry, blackthorn, and other rosaceous trees and shrubs. C.
- ▲ **Common Wave** *Cabera exanthemata*. White, sprinkled with yellowish grey. Outer cross-line distinctly curved. 5-9 in wooded areas, especially where moist. Larva is green with yellow rings and black spots and usually has purplish marks on the sides. It feeds on willows, alder, and various other trees.
- ▲ **Common White Wave** *C. pusaria* resembles Common Wave but is whiter (sometimes tinged with pink) and outer cross-line is virtually straight. 5-9, mainly in wooded country. Larva is normally purplish brown with white spots. It feeds on willows, birches, and various other trees.



- ▲ **V-Moth** *Macaria wauaria*. Forewings may be darker; dark V near front margin usually distinct, although posterior arm may be faint. 6-8 in gardens and open woods. Larva is green or brown with white lines and black dots. It feeds on gooseberry and currant.



- ▲ **Latticed Heath** *Chiasma clathrata* has dirty white to yellowish brown ground colour. Lattice is dark brown or black, always more reticulate than in Common Heath (p. 180). 4-9 in grassy places, mainly day-flying. Larva, green with white lines, feeds on clovers and trefoils.



- ▲ **Brown Silver-line** *Petrophora chlorosata*. Forewings sometimes tinged with pink. 5-7 on heathland and other bracken-rich habitats. Larva, dark green with brown lines, feeds on bracken fronds.



- ▲ **Straw Belle** *Aspitates gilvaria*. Forewings heavily speckled with brown in female. 6-8 in grassy places. Larva, pinkish grey with dark lines on the back, feeds mainly on low-growing plants. Local in S & C; mainly on chalk in B.



- ▲ **Psodos quadrifaria** Yellow bands may be narrower. Day-flying 6-7. Larva is brown and feeds on a wide range of low-growing plants. Alps and other mountains of S & C.

CADDIS FLIES Order Trichoptera

An order of nearly 6,000 species of holometabolous insects, almost all of which spend their larval life in water. About 400 species occur in Europe and 189 of them are found in the British Isles. The adults are mostly brownish, moth-like insects with relatively weak flight. Some fly by day, but most are active at night and often come to lighted windows and light traps, often quite a long way from water. There are normally four rather flimsy wings all covered with fine hairs, although the hindwings are generally less hairy and more transparent than the forewings. There are relatively few cross-veins, and the wings are held roofwise over the body at rest. The slender antennae, usually as long as the forewings and sometimes much longer, are held out in front of the head at rest. Ocelli are present or absent. Most adult caddis flies probably do not feed, although some species regularly lap nectar from waterside flowers. There is never a proboscis such as we find in most moths.

The head bears a pair of conspicuous maxillary palps, whose form is important in the classification and identification of the insects: some are very long, while others are short and swollen. Females always have 5-segmented palps, but the males of many species have fewer segments. The spurs on the tibiae are also valuable aids to identification, for their numbers vary from family to family. It is conventional to describe the spur pattern with a series of numbers: 2-2-4, for example, indicates that there are two spurs on the front tibia, 2 on the middle tibia, and 4 on the hind tibia. The spurs are usually very easy to see, but among the families Phryganeidae and Limnephilidae (p. 184) the legs also bear numerous spines, some of which may be at least half as long as the spurs. Take care that you really are looking at the spurs when counting them, and make sure that none has broken off in old or dried specimens.

The venation is another important factor in the identification of caddis fly families, although less easy to use. Classification revolves largely around the forking of the veins near the margin and also on the presence or absence of a discal cell near the centre of the forewing, but most of the caddis flies on the following pages can be recognised without looking at the veins. Separation of closely related species often necessitates examination of the genitalia.

Eggs are commonly laid in gelatinous masses in or on the water, although some are laid under stones on the beds of dried-up ponds and streams and hatch when the water returns in the autumn. A few species lay their eggs on overhanging vegetation and the larvae fall into the water when they hatch. The larvae are largely omnivorous, although some species show leanings towards either plant or animal food. The majority make portable homes or cases with small stones or plant fragments fitted on to a silken tube surrounding the body. The silk is produced by the larva's salivary glands. Each species builds to its own pattern, although closely related species have similar cases. The case is open at both ends, and more material is added to the front as the animal grows. The cases blend well with the surroundings and only the head and legs protrude when the larvae move about. A range of cases is shown on the following pages.

The larvae of some caddis flies are completely naked, while others shelter in silken nets. The latter are usually spun among water plants and they trap small animals and other food particles. Net-spinning species usually live in running water.

The insects pupate in their cases after cementing them to stones or other large objects. Species that make no larval cases construct simple pupation chambers of silk and sand. When the adult is ready to emerge, the pupa bites its way out of its case and swims to the surface or to the bank, where the adult bursts out and immediately flies away. The life cycle generally takes about a year.

▲ *Phryganea grandis* Phryganeidae. Spurs 2-4-4. Discal cell long and narrow. Male palps 4-segmented. Male is smaller and lacks black stripe in forewing. 5-8, with peak in early July; the largest British caddis fly. Breeds in still and slow-moving water, including large lowland rivers, with plenty of submerged vegetation. Case of spirally-arranged plant fragments. Absent from far south. ▲ *P. striata* is very similar but female has a more slender black stripe broken into 3 short dashes.

Oligostomis reticulata. Spurs 2-4-4. Mottled pattern combined with size readily distinguishes this species from most others. Hindwing has dark border and a dark stripe across the middle. Male palps 4-segmented. Larval case and habits like *Phryganea*. N & C. ▲ *Hagenella clathrata* is similar but has more dark clouding on hindwing. N & C.

Family Limnephilidae. A large family in which the front leg never has more than one spur; formula 1-3-4 in most species. Forewings parchment-like with few hairs; discal cell fairly long and obvious. Hindwings rather broad and very transparent.

▲ *Glyptotaelius pellucidus*. Spurs 1-3-4. Readily identified by strongly notched or concave outer margin of forewing. Female less strongly marked; forewing often plain yellowish brown. Abdomen generally greenish. 4-10. Lakes and ponds: case of pieces of dead leaves, completely concealing larva from above. Absent from Iberia.

▲ *Limnephilus lunatus*. Spurs 1-3-4. Forewings, as in all members of this large genus, narrow with an almost straight front edge and sharply truncated at tip. Markings black or brown and variable, but always a pale crescent on outer margin. 5-11. Breeds in all kinds of water: sometimes abundant in watercress beds. Case of overlapping leaf fragments and other debris, sometimes with added shells and sand grains.

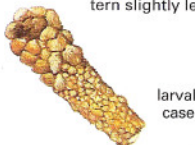
▲ *L. flavicornis* is similar but lacks pale crescent. Wings rather shiny; British specimens often much less marked, rarely with more than a dark line along rear edge of forewing. 5-11. Breeds mainly in small ponds. Case of various materials arranged in criss-cross fashion: occasionally made entirely of small shells. There are many other *Limnephilus* species, nearly all with clear patches on forewings, distinguished with certainty only by examining the genitalia.

▲ *Anabolia nervosa*. Spurs 1-3-4. Size very variable. Forewings often paler. 6-11. Breeds in still and running water but most common in streams. Case of sand grains, to which are attached a few of small sticks: the latter prevent trout and other fishes from swallowing the cases.

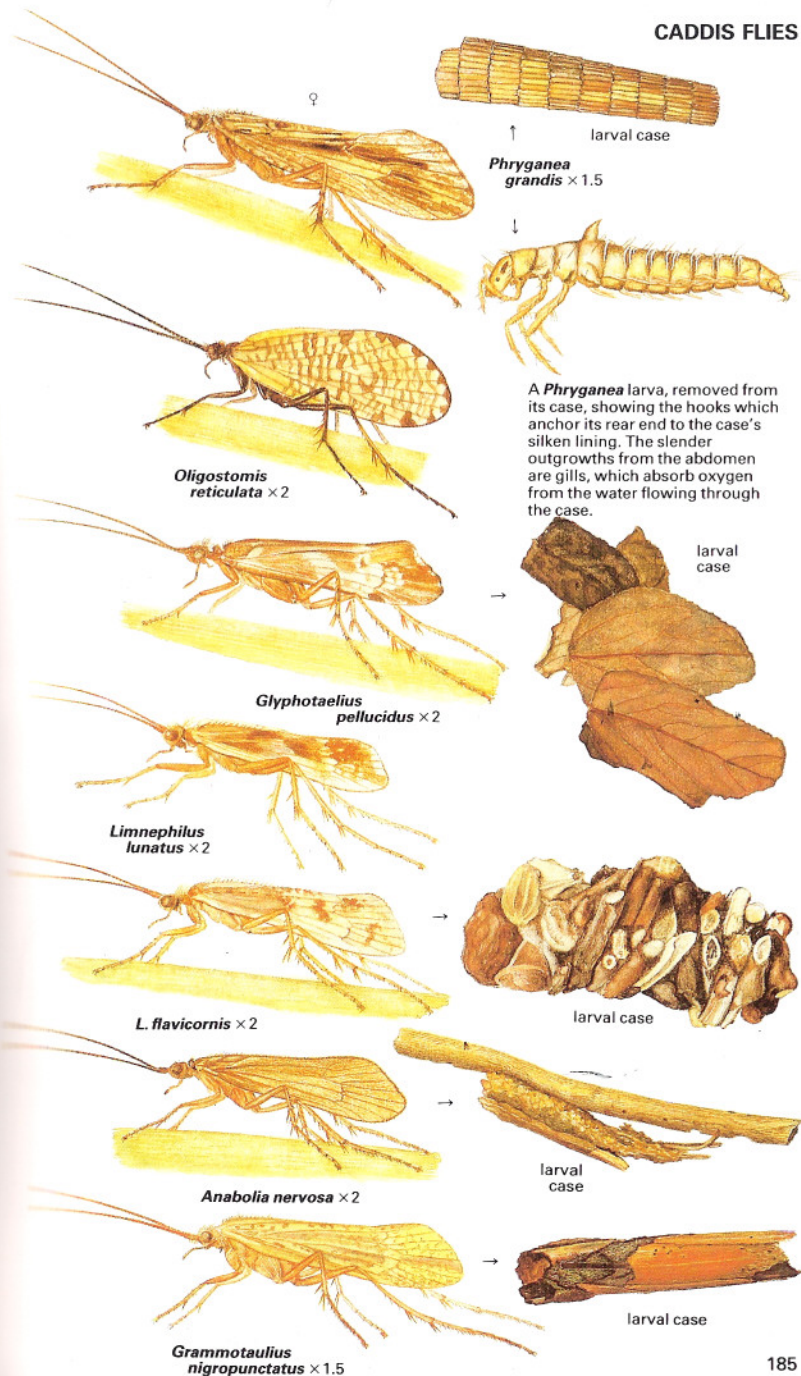
▲ *Grammotaulius nigropunctatus*. Spurs 1-3-4. Forewing rather pointed. Hindwing with an indented outer margin and a dark streak just in front of indentation: dark streak shows through delicate forewing at rest. 8-10. Breeds in marshy areas, including small ditches. Case of overlapping reed fragments. ▲ *G. nitidus* is larger and has a more pointed forewing, especially in the male. C.

▲ *Micropterna sequax*. Spurs 0-3-4 in male; 1-3-4 in female. 5-11. Very common at lights. Breeds in small, clear streams. Case of sand grains, but with a region of small stones, sharply demarcated, at the front. There are several similar species.

▲ *Halesus radiatus*. Spurs 1-3-3. Apex of forewing smoothly rounded, with a conspicuous pattern of finger-like, pale-edged grey streaks. Grey streaks and patches elsewhere in wing as well. 7-11. Breeds in running water. Case of assorted plant debris neatly fitted together: up to 3 slender twigs run the length of the case and project from both ends. ▲ *H. digitatus* is similar but larger: wing-tips slightly less rounded and pattern slightly less obvious. Case of debris and sand grains, but usually without sticks.



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A *Phryganea* larva, removed from its case, showing the hooks which anchor its rear end to the case's silken lining. The slender outgrowths from the abdomen are gills, which absorb oxygen from the water flowing through the case.

- ▲ *Brachycentrus subnubilus* Brachycentridae. Spurs 2-3-3, distinguishing this from near all other caddis flies: no other British species has this formula. Basal antennal segment stout and hairy. Male palps 3-segmented and very hairy. Female wings longer and more pointed. 3-7: very common around slow-moving rivers. Case of young larva made of plant debris and square in cross section: older cases of silk only and attached to vegetation. Larva strains food from water with comb-like middle legs.
- ▲ *Sericostoma personatum* Sericostomatidae. Spurs 2-2-4. Male palps 1-segmented and very broad and hairy: held in front of face like a muff. 6-9. Breeds in streams. Case of sand grains, very smooth and gently curved.
- ▲ *Goera pilosa* Goeridae. Spurs 2-4-4 and very conspicuous. Basal antennal segment very hairy. Male palps 3-segmented: 3rd segment long and bristly and held close to face. Body and wings yellow or greyish yellow. 5-9, around lakes and rivers. Case of sand grains with small pebbles at the sides.
- ▲ *Silo nigricornis*. Spurs 2-4-4. Basal antennal segment large and hairy. Male palps 3-segmented and very hairy: held in front of face. Male black when fresh: female brown. A hairy stripe runs through middle of male hindwing (see below). 5-8 near running water. Case like that of *Goera*. S & C. There are several similar species.
- ▲ *Lepidostoma hirtum* Lepidostomatidae. Spurs 2-4-4. Basal antennal segment longer than head and bearing long hairs. Male palps 2-3-segmented: short and club-like and very hairy. Male wings shorter and broader, with dark scales. 4-9. Breeds in still and running water. Case of vegetable debris and square in cross-section.
- ▲ *Hydropsyche pellucidula* Hydropsychidae. Spurs 2-4-4. Basal antennal segment slightly swollen. Last palpal segment much longer than the rest. No ocelli. Discal cell short and broad. Amount of mottling on forewing very variable. 5-9, flying in sunshine: very common. Breeds in still and slow-moving water. Larva spins net among gravel to trap food. There are many similar species, difficult to distinguish.
- ▲ *Philopotamus montanus* Philopotamidae. Spurs 2-4-4. Last palpal segment longer than all the others together (see below). Ocelli present. Hindwings smoky grey. 4-8, mainly around upland streams. Larvae are net-spinners in swift-flowing streams. Wing pattern readily distinguishes this species in B, but there are several similar species on the continent.
- ▲ *Polycentropus flavomaculatus* Polycentropidae. Spurs 3-4-4 and very large. Last palpal segment about as long as all the others together. No ocelli. Antennae brown with narrow yellow bands. Wings very hairy. Female up to twice size of male. 5-9: one of the commonest caddis flies. Larva spins pouch-shaped net in slow-moving water. There are several similar species.
- ▲ *Tinodes waeneri* Psychomyiidae. Spurs 2-4-4. Last palpal segment long and slender. No ocelli. Veins very distinct: discal cell short and broad. Hindwing narrow, with front edge slightly cut away towards tip (see below). 5-8. Breeds in lakes and rivers, spinning galleries of silk, attached to stones and usually coated with mud. There are several similar, but generally smaller species.
- ▲ *Psychomyia pusilla*. Spurs 2-4-4. Hindwing sharply pointed and with a small spike on front edge (see below). 5-9: day-flying in warm weather, often in great swarms. Breeds like *Tinodes* in streams and rivers.
- ▲ *Hydroptila sparsa* Hydroptilidae. Wings very narrow, pointed, and extremely hairy. Spurs 0-2-4. Often scuttles over waterside rocks and plants: 5-9. Breeds in still or running water. Larva naked until final instar, when it makes a silken, sausage-shaped chamber coated with fine sand grains. There are many very similar species.



Silo: hindwing of ♂



Tinodes hindwing



Psychomyia hindwing



palp of *Philopotamus*

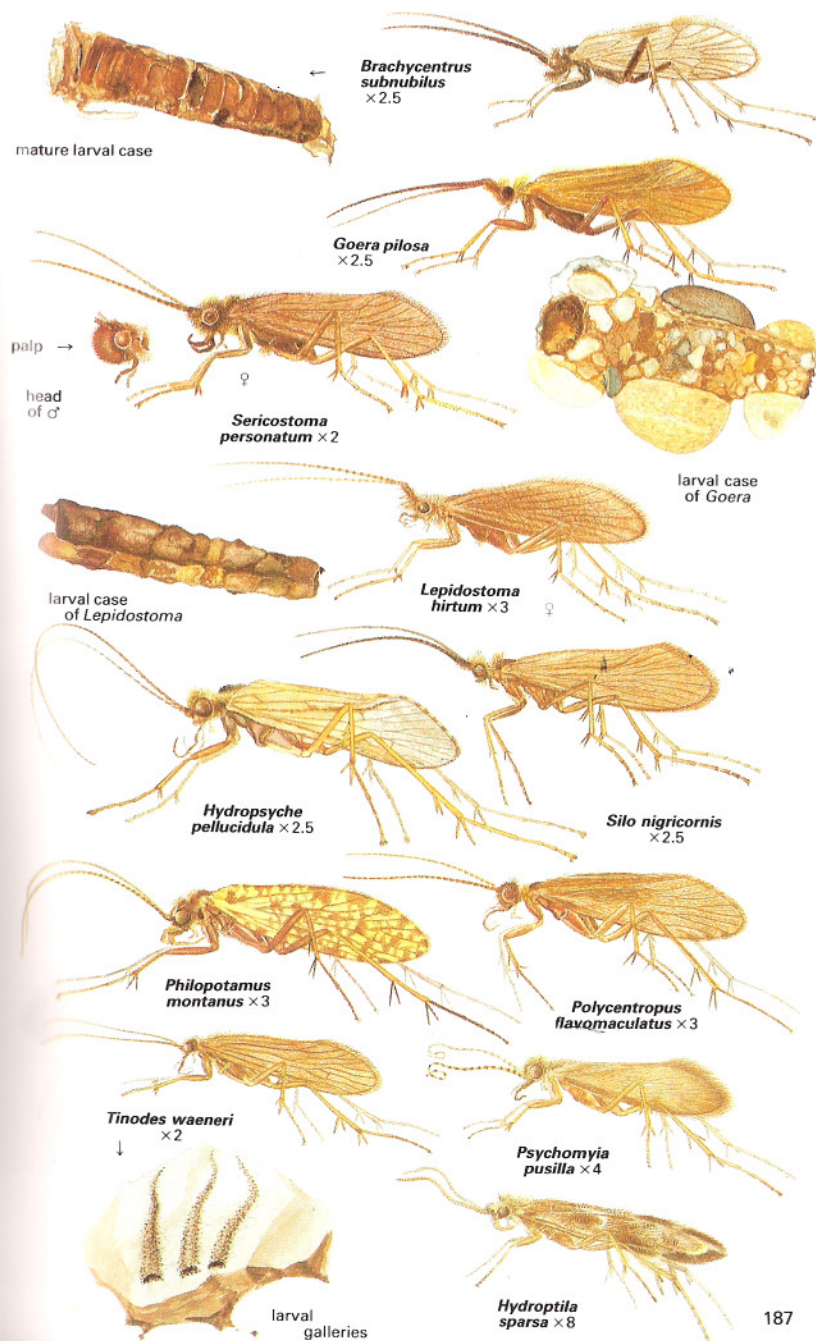


palp of female *Sericostoma*

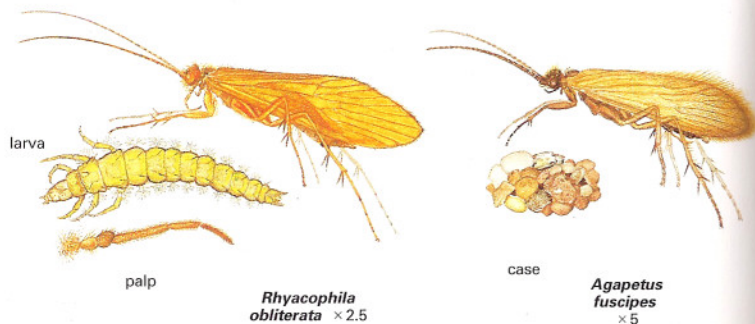


palp of female *Lepidostoma*

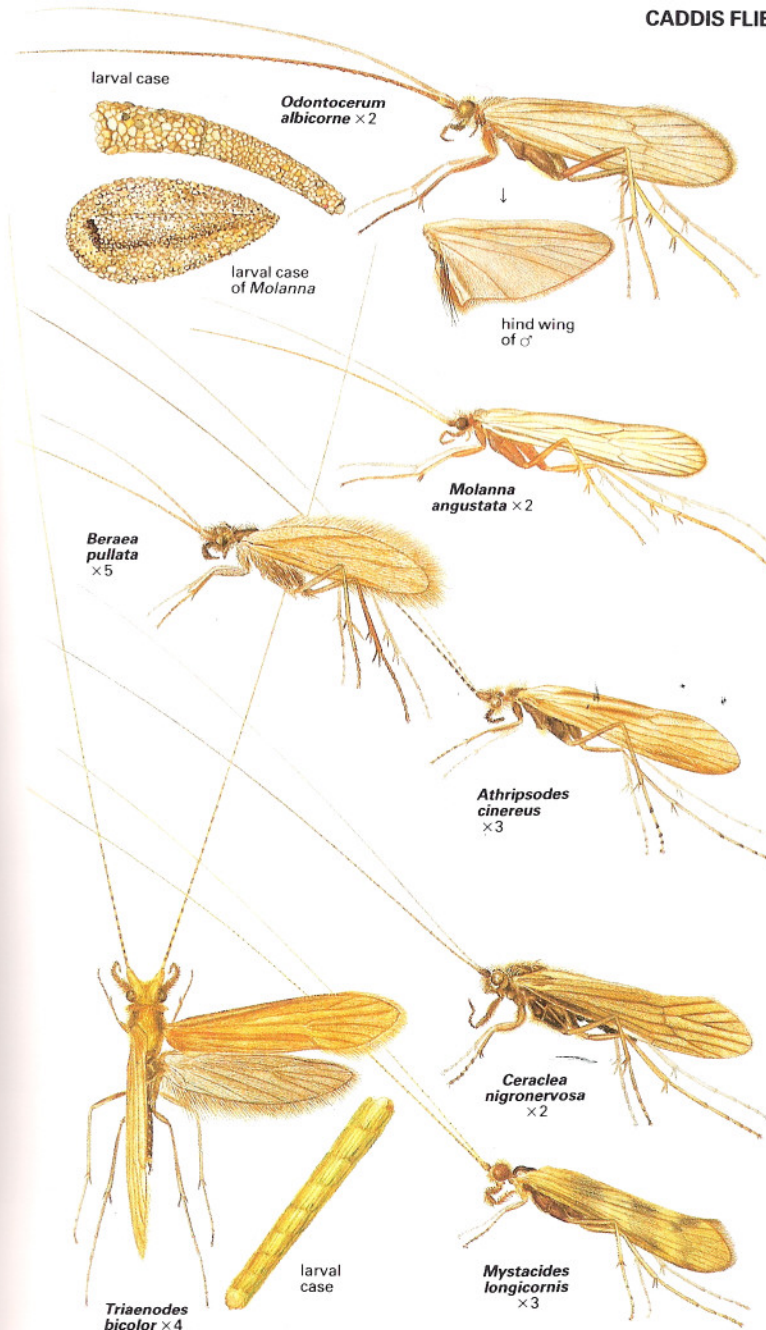
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- ▲ ***Odontocerum albicorne*** Odontoceridae. Spurs 2-4-4; large. Best distinguished by antennae, which appear distinctly toothed under a lens: basal antennal segment very thick. Wings silvery grey when fresh, becoming darker or yellowish with age. Hindwing of male with long tuft of hair along inner margin. Female larger than male. 6-10. Breeds in running water with stony bottom. Case of sand grains.
- ▲ ***Molanna angustata*** Molannidae. Spurs 2-4-4. No ocelli. Forewings dark grey to brown, with conspicuous venation, especially near tips. Legs rather long. Rests at an angle, with wings folded round body to resemble a piece of dead grass. 5-9. Breeds in slow and still-moving water with a sandy bottom. Case of sand grains: tubular, with a broad, flat shield on dorsal side. N & C.
- ▲ ***Beraea pullata*** Beraeidae. Spurs 2-2-4. No ocelli. Head projects forward between antennae. Palps long and stout; held upright in front of face in life. 5-7. Breeds in shallow water at edges of lakes and rivers, as well as in ponds and marshes. Case of sand grains: tubular and tapering and gently curved. There are several similar species.
- ▲ ***Athripsodes cinereus*** Leptoceridae. Spurs 2-2-2: all members of this large family have just 2 spurs on the hind tibia. Very long antennae, especially in males, are also a feature of the family. Palps very long and hairy. Colour and markings vary. Female smaller. 6-9: very common around lakes and large rivers. Case of sand grains: slender and tapering.
- ▲ ***Ceraclea nigronervosa***. Spurs 2-2-2. Body entirely black. Forewing veins rather conspicuous. Hindwing very broad and triangular. Palps long and hairy. Female smaller. 5-7, around lakes and large rivers. Flight strong. Case of secretion, with irregular bands of sand grains. N & C.
- ▲ ***Mystacides longicornis***. Spurs 0-2-2. Easily recognised as a rule by wing pattern, although this is occasionally obscured. Male eyes very large. Antennae very pale. Palps long and plumose and spread out to sides, almost like legs, at rest. 5-9: very common around lakes and ponds. Flight strong. Case of small stones or sand grains: almost straight and tapering very gently. Several closely related species have steely blue or black forewings.
- ▲ ***Triaenodes bicolor***. Spurs 1-2-2. Readily identified by chestnut forewings when fresh. Antennae distinctly ringed. Palps very long. 6-9: often abundant around lakes and ponds. Case of very regular, spirally-arranged green leaf fragments: long and straight. Larva swims with aid of feathery middle legs; prefers weedy ponds.
- △ ***Rhyacophila obliterata*** Rhyacophilidae. Spurs 3-4-4: large. First 2 palpal segments short and thick, the 2nd being almost spherical. Ocelli present. 6-9, mainly around upland streams. Larva makes no case and lives freely on stream bed. There are several closely related species, but *obliterata* is easily recognised by bright yellow wings when fresh, although colour fades after death.
- ▲ ***Agapetus fuscipes*** Glossosomatidae. Spurs 2-4-4. First 2 palpal segments short and thick. Wings narrow, black with golden hairs. Male has long yellow spine under abdomen. 5-12: one of the commonest caddis flies. Breeds in fast-flowing streams with stony bottoms. Case of small stones, domed above and flat below: often clothing submerged rocks in vast numbers.



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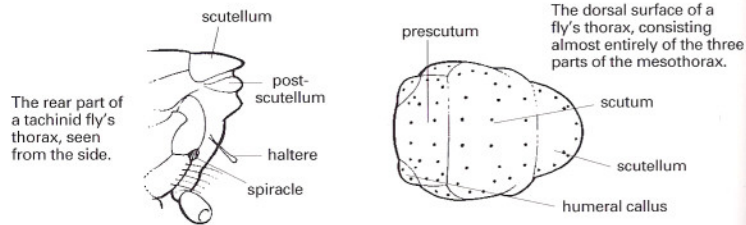


TRUE FLIES Order Diptera

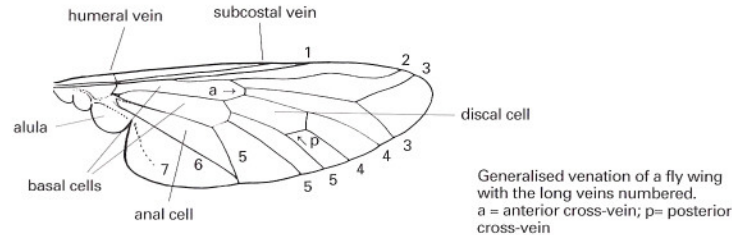
An immense order of insects containing nearly 100,000 known species. The hindwings are reduced to minute pin-shaped structures known as halteres or balancers, which act as gyroscopes and help to maintain stability in flight. The single pair of membranous wings gives the order its name: 'two-winged'. A few species, mainly ectoparasites (p. 213), are entirely wingless.

Although a few hover-flies (pp 204-206) are able to crush pollen grains, flies feed essentially on liquids: mainly nectar, but many other liquids too. The females of mosquitoes, horse-flies, and several other groups feed mainly on blood, attacking both man and his domestic animals to get it. The blood-sucking in itself is serious only where the insects exist in huge numbers, but many carry dangerous diseases, such as malaria. The flies' mouth-parts vary with the diet. Female mosquitoes have needle-like jaws that fit neatly together to form a hypodermic syringe, complete with a protective sheath that is drawn back when the insect is about to pierce a victim. Female horse-flies have more blade-like jaws that cut the victim's skin: a fleshy pad then mops up the blood flowing from the wound. House-flies and blow-flies depend entirely on mopping up surface fluids with a pair of spongy pads at the tip of the mouth-parts, although they can deal with soluble solids like sugar by pouring digestive fluids on to them first. They spread disease by regurgitating over our food after sampling dung or carrion. Some flies do not feed at all as adults.

Compound **eyes** are always present, and often so large that they meet on the top of the head. This holoptic condition is most often found in males, but the females of some species also have it. The presence or absence of **ocelli**, which generally form a small triangle on the top of the head, often helps with identification, as do the form of the **antennae** and the arrangement of bristles on the head and **thorax**. The bulk of the thorax consists of the wing-bearing mesothorax, with the roughly triangular scutellum often prominent at the rear. In some flies, notably the parasitic tachinids (p. 212), there is also a post-scutellum bulging from underneath the scutellum itself. Each **foot** normally has two small pads, but some groups of flies have three on each foot.



Wing venation is extremely variable. Several schemes are in use for naming and numbering the veins: here we have used a simple numbering system for the major veins. Very close to the base of the front margin there is a small and often inconspicuous vein called the humeral vein. The sub-costa runs close to the front margin, often joining it about half way along although it reaches almost to the wing-tip in some species. The other main veins, sometimes termed long veins, can be numbered from the front. The first is commonly known as the radius, while the last two (6 & 7) are the anal veins. Venation is much reduced in many flies, especially towards the rear of the wing, and is often complicated by the branching of some or all of the veins. Some veins also fuse together, and it is not always possible to determine which vein is which simply by counting. But there are some useful clues: the anterior cross-vein always links veins 3 and 4, while the posterior cross-vein - usually near the centre of the wing - links 4 and 5. Many species have a discal cell near the centre: its shape varies a good deal, but the anterior cross-vein generally joins its anterior margin. Between the discal cell and the wing-base are generally two basal cells, whose relative shapes and lengths are important. The anal cell, if present, lies just behind the basal cells.



The front or costal margin of the wing sometimes has one or two minute breaks in it, usually quite near the base and mainly in the smaller flies. The hind margin of the wing may have one or more distinct lobes near the base. The outer lobe, known as the alula, is generally the biggest and is quite obvious. The inner lobe, known as the calypter or thoracic squama, is generally minute, but in some flies - notably the house-flies and blow-flies - it forms a prominent flap over the haltere. These flies are known as calypterate flies.

Classification The flies are grouped into three sub-orders: Nematocera, Brachycera, and Cyclorrhapha. Members of the **Nematocera** (pp 192-197) have slender, many segmented antennae which are usually longer than the head and thorax together. Most of the segments are alike and there is no bristle or arista at the tip. The anal cell, if present, is open and gets wider towards the margin.



The **Brachycera** (pp 198-205) are mostly much stouter flies whose antennae are always shorter than the thorax (Brachycera = short-horn). The antennae are quite stout and often horn-like. They are basically 3-segmented, although the 3rd segment is often strongly ringed and the antennae then appear to be many-segmented. Many have a terminal bristle. The discal cell is nearly always present and the anal cell is closed or strongly tapered towards the wing margin.

In the **Cyclorrhapha** (pp 204-216), the antennae are usually much less prominent. The three main segments are generally pendulous, and a slender bristle springs from the dorsal surface of the 3rd segment rather than from the tip. In most species, only the bristle is visible from above. It is the young stages, however, that reveal the main differences between the Brachycera and the Cyclorrhapha.

Larvae and Life Histories The larvae of flies are incredibly varied in form and habits, some living on land and some in the water, some inside plants, and others as parasites inside various other animals. They include many serious agricultural pests. The larvae have no true legs, although many have fleshy outgrowths that help them to wriggle about. The head is quite prominent in many nematocerans, and equipped with biting jaws. The brachyceran larva has a much-reduced head, which can be retracted into the thorax, although it still has biting jaws. The cyclorrhaphan larva has no real head and is the familiar, tapering maggot. Its jaws, at the narrow end, are represented by minute hooks whose main function is to scrape and tear at the food and release fluids that the maggot can imbibe.

There are normally four larval instars among the nematocerans, five to eight in the brachycerans, and only three in the cyclorrhaphans. The **pupa** is quite mobile in the first two groups, very much so in the mosquitoes and some other families. But the cyclorrhaphan pupa is quite immobile inside a hard, barrel-shaped puparium, formed from the hardened final larval skin. When ready to emerge, the pupa inflates a sac at the front of the head and the pressure forces up a round lid. The pale sac, known as the ptilinum, can often be seen in freshly-emerged flies, which therefore appear rather deformed, but it soon deflates and recedes into the head, leaving just a faint groove, shaped like an inverted U, around the bases of the antennae.