

et al. 1974). Martini (1931) reported the species (as *Cx. univittatus*) as biting humans inside houses at night.

Distribution: This species is recorded in Portugal, Spain, Italy including Sicily, Macedonia, Bulgaria, Greece, and Turkey (Snow and Ramsdale 1999). *Cx. perexiguus* is found in Asia Minor, south western Asia towards India, and in northern Africa (Harbach 1988).

Medical importance: From Israel and Egypt *Cx. perexiguus* has been reported as a vector of WNV (Harbach 1988).

Notes on systematics: The species name which has hitherto been used for European material is *Cx. univittatus*, but Harbach (1999) stated that *Cx. univittatus* is restricted to the temperate highlands in the East African Subregion of the Afrotropical Region and identified a few specimens from Greece, Italy, and Turkey as *Cx. perexiguus* based on characteristics of the male genitalia and larvae. He suggested regarding the species which occurs in southern Europe, that it should be rather *Cx. perexiguus* than *Cx. univittatus*, although Eritja et al. (2000) confirmed the presence of *Cx. univittatus* in Spain.

Culex Pipiens Complex

The complex consists of several species, subspecies, forms, races, physiological variants, or biotypes according to various authors. At present it includes the names *Cx. pipiens pipiens* Linnaeus, *Cx. p. pipiens* biotype *molestus* Forskal, *Cx. p. quinquefasciatus* Say, *Cx. p. pallens* Coquillett, *Cx. restuans* Theobald, and *Cx. torrentium* Martini in the Holarctic as well as two Australian members, *Cx. australicus* Dobrotworsky and Drummond and *Cx. globocoxitus* Dobrotworsky.

The status of the three first names has been taxonomically stabilized by designation of neotypes (Sirivanakarn and White 1978; Harbach et al. 1984, 1985). It is now generally accepted that the former *Cx. pipiens molestus* (Harbach et al. 1984) is not separated from the subspecies *Cx. pipiens pipiens* and is designated as a biotype, as no genetical differences have been found (Bourguet et al. 1998). However, new data based on protein electrophoresis revealed a significant genetic distance between the two forms (Becker et al. 1999).

The females of the complex are very difficult to separate in field material. In several reared populations it took eight variables and a discriminant analysis to

discern between *pipiens*, *molestus*, and *quinquefasciatus* females and overlapping was considerable (Kruppa 1988). Thus, there is no reliable characteristic yet for discrimination between *pipiens* and *molestus*.

The former *Cx. quinquefasciatus* Say and *Cx. quinquefasciatus pallens* Coquillett are currently regarded as subspecies of *Cx. pipiens* (Miller et al. 1996). They freely hybridize but show a difference in the male hypopygial morphology (Kruppa 1988). *Cx. pipiens pipiens* and *Cx. torrentium* are two separate sibling species (Harbach 1985; Dahl 1988; Harbach 1988; Miller et al. 1996) defined by genetic characteristics and different morphology in some life stages.

***Culex (Culex) pipiens pipiens* Linnaeus 1758**

Female: A medium sized mosquito, with a yellowish brown to dark brown integument. The antennae are dark, and the pedicel and flagellomere I have a few tiny white scales. The palps are mainly black scaled, and the proboscis has cream coloured scales ventrally. The head has dark forked scales and some paler scales laterally. The scutum has delicate golden brown scales, which are lighter laterally. The scutellum has narrow, pale yellow scales and dark setae. The postpronotum has golden brown scales. The pleurites have yellowish or white scale patches on the mesepisternum. Postspiracular and prealar scales are absent, or rarely a few scales may be present. The absence of scales in *Cx. p. pipiens* provides an almost reliable characteristic for separation from *Cx. torrentium* females which have a few prealar scales when undamaged. The coxae have a small patch of dark scales, the femora have a yellowish apical border but otherwise are dark scaled, and the hind femur has mostly whitish scales. The tibiae and tarsi are dark scaled, the hind tibia lacks a longitudinal pale stripe (Fig. 6.55b). The scaling of the wings is dark, and the subcosta (Sc) intersects the costa (C) beyond the furcation of R_{2+3} (Fig. 6.52b). The abdominal terga are predominantly dark scaled; tergum II has a small basomedian whitish spot, and terga III–VII have whitish to yellowish, narrow basal bands which expand laterally (Fig. 6.54b). The sterna are yellowish scaled.

Male: The subapical lobe of the gonocoxite has seven large, simple and one broad scale like setae (Fig. 10.103). The gonostylus is broad with several small and two spiniform setae apically. The aede-



Fig. 10.103 Hypopygium of *Cx. p. pipiens*

gus has several complicated plates and lobes of which the ventral and dorsal arms are diagnostic characteristics and are used for the so called DV/D formula (Sirivanakarn and White 1978; Ishii 1991). The shape of the ventral arm is slender, blade-like with a sharply pointed apex. The dorsal arm is tubular, stout, and distinctly truncated at the apex (Fig. 7.64b). The ventral arm of the paraproct varies in length from being an inconspicuous knob to a conspicuous extension which is never recurved. The paraproct has numerous stout setae forming a brush-like crown. It is possible to distinguish it from *Cx. torrentium* by the blunt apex of the dorsal arm and a different shape of the ventral arm of the paraproct, which is long, sclerotized, and recurved at the apex in *Cx. torrentium*.

Larva: The head is wider than long, and the antenna is shorter than the head. The postclypeal seta (4-C) is short and simple, and all frontal setae are long. The inner frontals (5-C) have 5–6 branches, the median frontal seta (6-C) is 4–5 branched, and the outer frontals (7-C) have 6 branches. The prothoracic setae 1-P to 3-P are long and single, 4-P has 2 branches and is somewhat shorter than the other setae, 5-P and 6-P are single and long; 7-P is 2-branched and long. The metathoracic seta 1-T is shorter than half the length of 2-T. The number of comb scales is about 40, each individual scale is short and widened at the apex, and evenly fringed. The siphon is slender, evenly tapered towards the apex, and the siphonal index

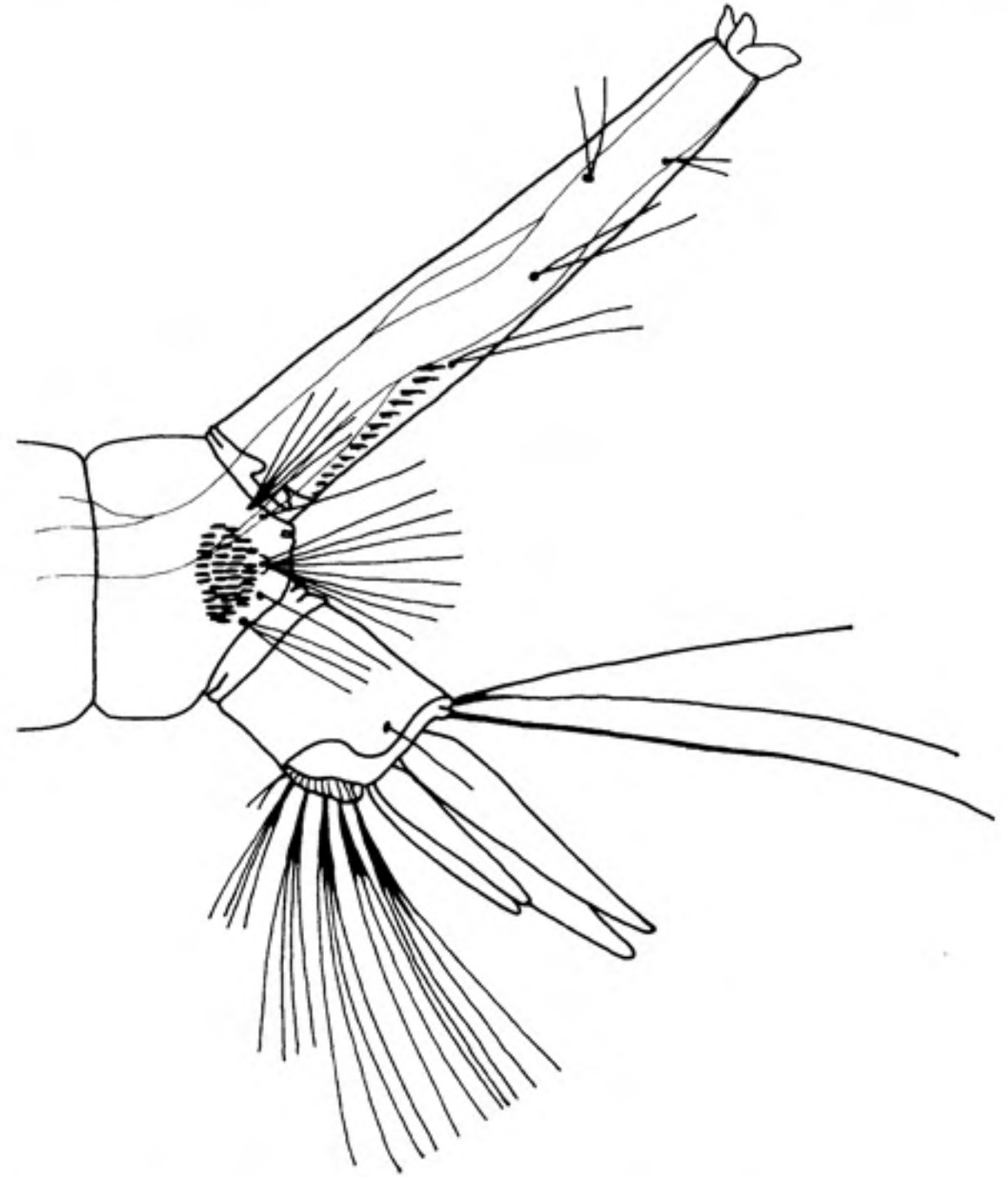


Fig. 10.104 Larva of *Cx. p. pipiens*

ranges between 4.8 and 5.0 (Fig. 10.104). The number of pecten teeth is 13–17, evenly spaced up to seta 1a-S. Each pecten tooth has a long pointed tip and three lateral denticles. The siphonal tuft (1-S) consists of four widely spaced 2-branched pairs of setae which arise distal to the pecten in an irregular row. The anal papillae are elongate, and the dorsal pair is twice as long as the saddle. The larvae of the species complex are very similar. Those of *Cx. p. pipiens* and *Cx. torrentium* can only be distinguished from each other when the specimens are very well preserved; differences in abdominal setation are as indicated in the keys (Fig. 8.77c). The larvae of *Cx. p. quinquefasciatus* have a significantly shorter siphon (the siphonal index is about 4.0).

Biology: Females usually do not feed before entering winter shelters; the specimens which have taken a small blood meal before overwintering have a poorer chance of surviving (Mitchell and Briegel 1989). Overwintering females lay their eggs on the water surface in batches as egg rafts of usually 150–240 eggs. The larvae hatch within 1 or 2 days and complete their development to adults in about one to a few weeks, depending on the temperature. They are able to inhabit nearly every kind of water source. The first larvae

often occur together with those of *Anopheles* species and can be found in semi permanent waters, larger pools with vegetation, rice fields, along river edges in still zones, and in inundation areas; occasionally even in tree-holes. The larvae frequently occur in man-made water bodies such as flooded cellars, construction sites, water barrels and tin cans, metal tanks, ornamental ponds, and containers in gardens and in churchyards. They even tolerate a small amount of salinity and can occur in rock pools. The species can develop up to several generations per year depending on climatic conditions. The females are anautogenous, ornithophilic, eurygamous, and diapausing in wintertime. Occasionally they have been observed to feed on wild mammals or on mice in the laboratory. In southern France, anautogenous populations with stenogamous males of *Cx. p. pipiens* have been reported from the field. Its biotype *molestus* occurs more frequently in human environments.

Distribution: *Cx. p. pipiens* is widespread in the Holarctic region and found throughout Europe. Its distribution seems to be more northern in the easternmost European parts than in Scandinavia. Its northern borders throughout Europe need renewed analysis, as it has not always been distinguished from *Cx. torrentium*. It has been introduced into Australia and also into South America and eastern and South Africa. In the southeasternmost areas of the northern hemisphere *Cx. p. pipiens* occurs sympatrically with *Cx. p. quinquefasciatus*.

Medical importance: *Cx. p. pipiens* seems to play a minor role as an arbovirus vector in Europe. Nevertheless, one report of high incidence of WNV from Romania (Nicolescu 1998) and a record of low incidence of Ockelbo virus from wild caught females (Lundström 1994) demonstrate the capacity of the species for arboviruses.

Notes on systematics: The species is highly variable in its pattern of integument and scaling colour, hence it has numerous synonyms worldwide. From European material nine valid synonyms exist (Knight and Stone 1977; Knight 1978; Ward 1984, 1992). Two further invalid subspecies descriptions on European material and now treated as synonyms, are the former *Cx. p. torridus* Iglisch and *Cx. p. erectus* Iglisch (Dahl 1988; Harbach 1988). There are different views as to the specific status of *Cx. pipiens* and *Cx. quinquefasciatus*. They are still regarded as one species based on their mode of hybridisation and molecular studies

which have not confirmed a species specific status (Bourguet et al. 1998). However, the males can be separated by morphological characteristics (Sirivanakarn and White 1978; Kruppa 1988).

***Culex pipiens pipiens* biotype *molestus* Forskal 1775**

The biotype cannot be distinguished from *Cx. p. pipiens* on a single morphological characteristic in adults. Kruppa (1988) found a statistical difference in the larval mentum between *pipiens*, *quinquefasciatus*, and *molestus* in reared strains. No reliable genetic marker was found to separate *molestus* from *pipiens* (Bourguet et al. 1998). However, four biological criteria for the biotype *molestus* have been established: autogeny, stenogamy, anthropophily, and facultative diapause.

Female and male: Colouration, setae, and scaling of head, thorax, abdomen, wings, and legs as in *Cx. p. pipiens* (Harbach et al. 1984). The males are stenogamous, meaning copulation with females in very limited spaces without swarming is possible. This has led to a search for male morphological characteristics to distinguish between *pipiens* and *molestus* (Oljenicek and Zoulova 1994). The first character was found in the length of palpomere IV, which gave a reliable difference from that of *molestus*, being 1.5 times longer than that of *pipiens*, a result in contrast to earlier observations (Harbach 1988). The second character is the average length of the antennal seta compared to the average length of the antenna, expressed in an antennal index. This index is 3.5 in *pipiens* and ranges between 4.1 and 4.4 in *molestus*. These morphometric parameters were measured on reared material.

Larva: The morphological characteristics are so variable that only identification based on eight characters with statistical analysis gave some discrimination between *pallens*, *molestus*, and *pipiens*. More reliable is the discrimination between all three mentioned taxa against *Cx. p. quinquefasciatus* (Kruppa 1988). However, it is claimed by many authors that a difference in the siphonal length can be found with a shorter siphon in *molestus* than in *pipiens* (Oljenicek and Zoulova 1994). Previously, this was correlated with highly polluted larval habitats characterized by a high content of ammonia (Gabinaud et al. 1985).