

LIFE STAGES OF
GLYPTOTENDIPES BARBIPES (STAEGER) WITH A BRIEF
ACCOUNT OF SILK SPINNING BY THE LARVA *

ESTÁGIOS DE VIDA DE
GLYPTOTENDIPES BARBIPES (STAEGER)
COM NOTA SOBRE A TECELAGEM DE SEDA PELA LARVA

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The adults of **Glyptotendipes barbipes** was first made known by STAEGER (1839) from Denmark and later by JOHANNSEN (1905), EDWARDS (1929), GOETGHEBUER (1937) and TOWNES (1945). The immature forms of the species was first described by GOETGHEBUER (1937) from Europe and later expanded by workers like GRODHAUS (1967) and SUBLETTE & SUBLETTE (1973) with the help of SEM. This paper presents detailed account of the egg, larva, pupa and both sexes of **Glyptotendipes barbipes** reared in the laboratory during summer and winter respectively. The paper also gives a brief account of silk spinning method by the larva studied in the laboratory.

MATERIALS AND METHODS

The egg mass from the submerged plants of the pond and rice field was brought in the laboratory and kept in opaque plastic trays (8 cm in diameter) containing water to a depth of 3-4 cm bottom layer of autoclaved mud. Immediately after hatching, the

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larvae were transferred to other trays (30 x 20 x 6 cm) having the same water and layer of mud. A little amount of activated charcoal and sand were put in the rearing trays covered with a nylon cage (40 x 30 x 30 cm). The larvae were maintained with food consisting of rabbit chow, Baker's yeast and milk powder at room temperature of $32 \pm 2.5^\circ \text{C}$ and $24 \pm 2.5^\circ \text{C}$ with 50-70 % and 20-42 % humidity in summer and winter respectively until pupation or eclosion to the adults.

The eggs, larvae, pupae and the imagines were processed and mounted on microslides for study after the techniques of SASA (1978) and CHAUDHURI *et al.* (1983).

We have followed SAETHER (1980) in describing the morphology and terminologies of the species.

All measurements are in millimeter (mm) and the number before parentheses indicates the average value and those within the parentheses are in minimum-maximum followed by "n" being the number of specimens considered.

The materials of the present study are in the collection of insects (BUENT) and will be deposited to the National Zoological Collections, Calcutta, British Museum (Natural History), London and U.S.N.M., Washington D.C. in due course.

GLYPTOTENDIPES BARBIPES (STAEGER)

Chironomus barbipes Staeger, 1839: 561.

Glyptotendipes barbipes; Johannsen, 1905: 76; Edwards, 1929: 392; Goetghebuer, 1937: 107; Townes, 1945: 140; Grodhaus, 1967: 4; Sublette and Sublette, 1973: 81.

EGG

Eggs are laid in a tubular gelatinous mass with a suspensory stalk; each mass containing numerous greenish eggs. When freshly laid it appeared to be a compact structure but it swelled in water and assumed a tubular shape. Eggs are arranged spirally and became brown towards hatching. The remaining egg capsules are pale in colour.

LARVA (FOURTH INSTAR)

Colour of the larvae dark red. Colour of exuviae, transparent with brown sclerotized head capsule, claws of the anterior and posterior parapods and setae. Body length 7.05 (6.12-9.8,

n=10).

Head -- Colour yellow. Posterior occipital margin of head capsule with bifurcated dark brown border and with vestiges of tentorial pit. Ventral head capsule 0.45 (0.45-0.5, n=10) long. Eye spots 2 pairs, dorsal ones dumbbell shaped and little larger than the posterior ones and reniform. Antenna (Fig. 1 a) 5 segmented, basal antennal segment 0.09 (0.08-0.1, n=10) long and 0.03 (0.02-0.03, n=10) wide; peg sensillum distinct, with a ring organ 0.01 (0.009-0.011, n=10), blade of basal antennal segment 0.064 (0.062-0.067, n=10) long, accessory blade 0.016 (0.016-0.017, n=10) long; lauterborn organ 0.009 long; length ratio of antennal segment I-V 24 : 9 : 6 : 5.5 : 1.5, AR 1.07 (1.06-1.12, n=10). Labral lamella more or less triangular, seta anteriores (Fig. 1 b) pectinated 0.021 (0.02-0.025, n=10) long, seta posteriores simple 0.048 (0.046-0.049, n=10) long, seta minuscula distinct, seta bisensilla distinct, chaetae of labrum 5 pairs, chaetulae lateralis of palatum 5 pairs well pectinated at the apex, spinulae scale like 2 pairs, distinct bases of 1 pair of setae premandibularis on the tormal bar. Pecten epipharyngis (Fig. 1 c) single, platelike with 31-32 unequal teeth. Premandible (Fig. 1 d) brown 0.14 (0.13-0.15, n=10) long with 2 dark apical teeth. Premandibular brush well developed at the mid margin. Mandible (Fig. 1 e) 0.24 (0.24-0.26, n=10) long with 1 dark brown apical and 3 lateral teeth, size decreases towards laterad, seta subdentalis lanceolate 0.025 (0.025-0.027, n=10) long, seta interna with 4 main plumose branches, seta externa 2, ring organ of mandible 0.014 (0.012-0.016, n=10) in diameter, distance of ring organ from base 0.032 (0.032-0.033, n=10) mandibular brush mostly stiff, straight setae apically curved. On mola smooth. Maxilla (Fig. 1 f) with well developed lamellea of galea, anterior chaeta broad and blunt, lacinial chaeta leaf like with pectinated inner margin, a number of setae also present, antaxial and paraxial seta well developed, sensillum basiconica 1, pecten gallearis 0.024 (10) long; maxillary palp 3-segmented, first segment of maxillary palp 0.038 (0.038-0.04, n=10) long and 0.024 (0.024-0.025, n=10) wide with 4 sensilla, ring organ 0.004 (10) in diameter on the ventromedial sclerite, setae maxillaries 4 in number. Premento-hypopharyngeal complex with a distinct tongue shaped apically broad median lamella 0.033 (0.032-0.036, n=10) wide and 2 broad paramedian lamellas apically serrated, 5 pairs sensilla each with a chitinised U-bar and a basal ring and nume-

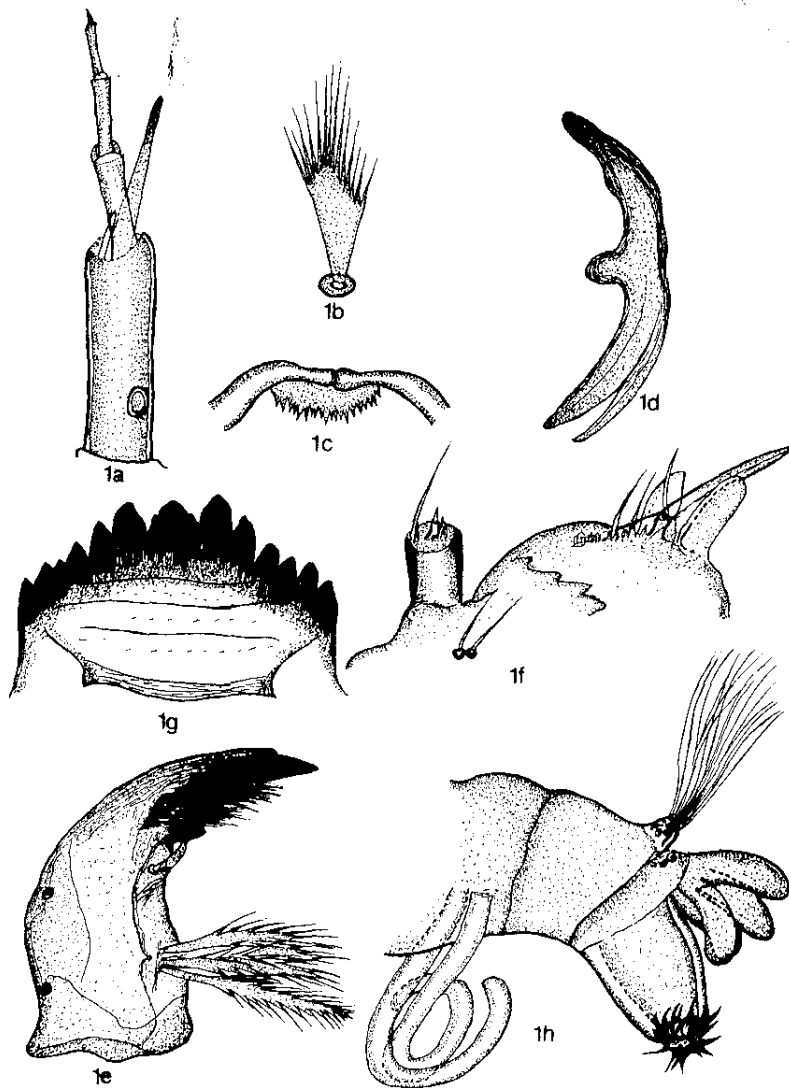


Fig. 1. Fourth instar larva of *Glyptotendipes barbipes* (Staeger). a, antenna; b, seta anteriores; c, pecten epipharyngis; d, premandible; e, mandible; f, maxilla; g, mentum and h, posterior abdominal segments.

rous chaetulae at the outer corners of prementum, mentum (Fig. 1 g) dark brown 0.1 (0.09-0.16, n=10) long and 0.24 (0.19-0.26, n=10) wide with 1 median tooth 0.02 (0.02-0.03, n=10) long and 0.02 (0.02-0.03, n=10) wide and 7 pairs of lateral blunt teeth, ventromental plate fan shaped 0.07 (0.06-0.08, n=10) wide with distinct rays. V/M 3.03 (2.6-3.5).

Abdomen (Fig. 1 h) — colour of abdomen dark red. Abdominal segment XI with a pair of ventral tubules. Anterior parapods with numerous claws. Procercus 0.033 (0.029-0.038, n=10) high and 0.046 (0.042-0.046, n=10) wide at base, each with 8 anal setae 0.75 (0.68-0.81, n=10) long and 2 lateral setae; supra anal seta 0.26 (0.23-0.28, n=10) long, Sa/An 0.33 (0.32-0.34). Anal tubules 2 pairs stout, slightly curved 0.24 (0.23-0.28, n=10) long. Posterior parapods 0.35 (0.32-0.45, n=10) long each with 15-16 well sclerotised claws of three different sizes and shapes.

MATERIAL EXAMINED — Ten larvae and four exuvia (reared in the laboratory).

PUPA

Colour of pupa brown, colour of exuvium gray. Total length of body 6.51 (6.45-7.01, n=10) in male and 8.02 (7.58-8.35, n=10) in female.

Cephalothorax — Colour brown. Frontal plate (Fig. 2 a) with one pair of small elevated triangular frontal tubercles 0.05 (0.04-0.06, n=10) diameter at the base and 0.06 (0.06-0.08, n=10) in height, frontal seta subapical 0.07 (0.07-0.09, n=10) long. Antennal sheath in male (Fig. 2 b) 1.39 (1.37-1.45, n=10) long, and in female (Fig. 2 c) 0.072 (0.62-0.76, n=10) long. Thorax rugulose wing sheath pale 1.58 (1.42-1.68, n=10) long. Respiratory organ (Fig. 2 d) with oval base and bunch of fine 14 branched filamentous structures, base of organ 0.14 (0.13-0.15, n=10) wide. Precorneal setae 2.

Abdomen (Fig. 2 e) — Colour brown and nine segmented. Segment I with a pair of basolateral pedes spurii B, segment II with a pair of caudolateral "pedes spurii B", segments IV-VI each with "pedes spurii A" at each caudolaterad, "pedes spurii A" of segment IV pronounced and gradually diminished towards segments V-VI. Tergite II (Fig. 2 f) with broad median band of spinules and caudal of spines interrupted at and a transverse row of overlapping 68-70 curved hooks, tergites III-V with

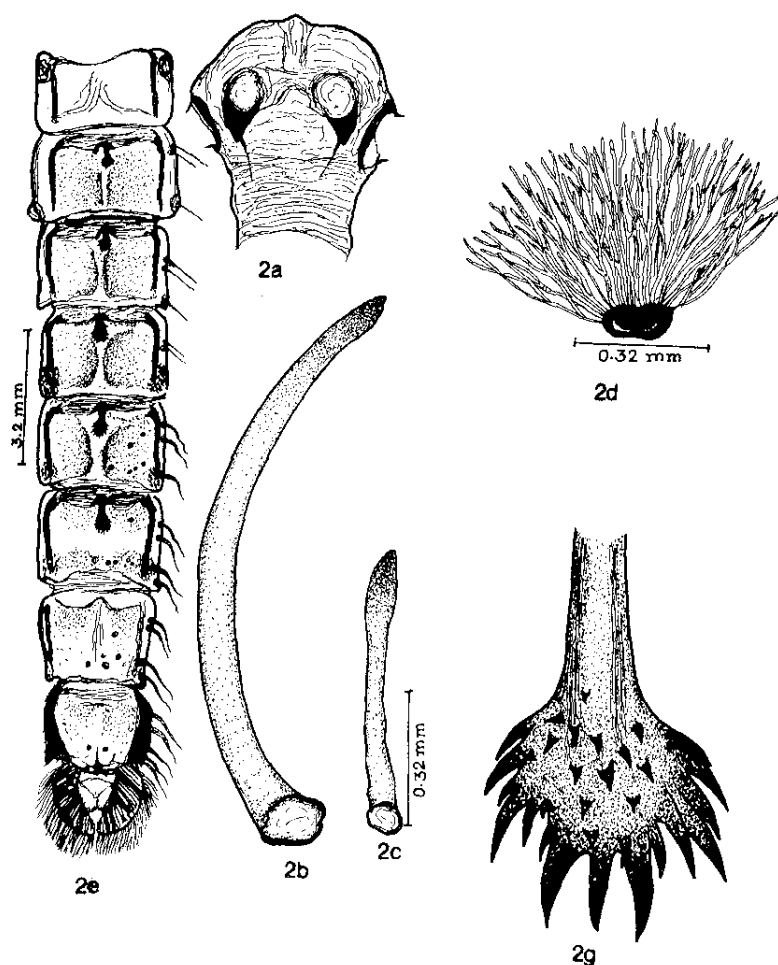
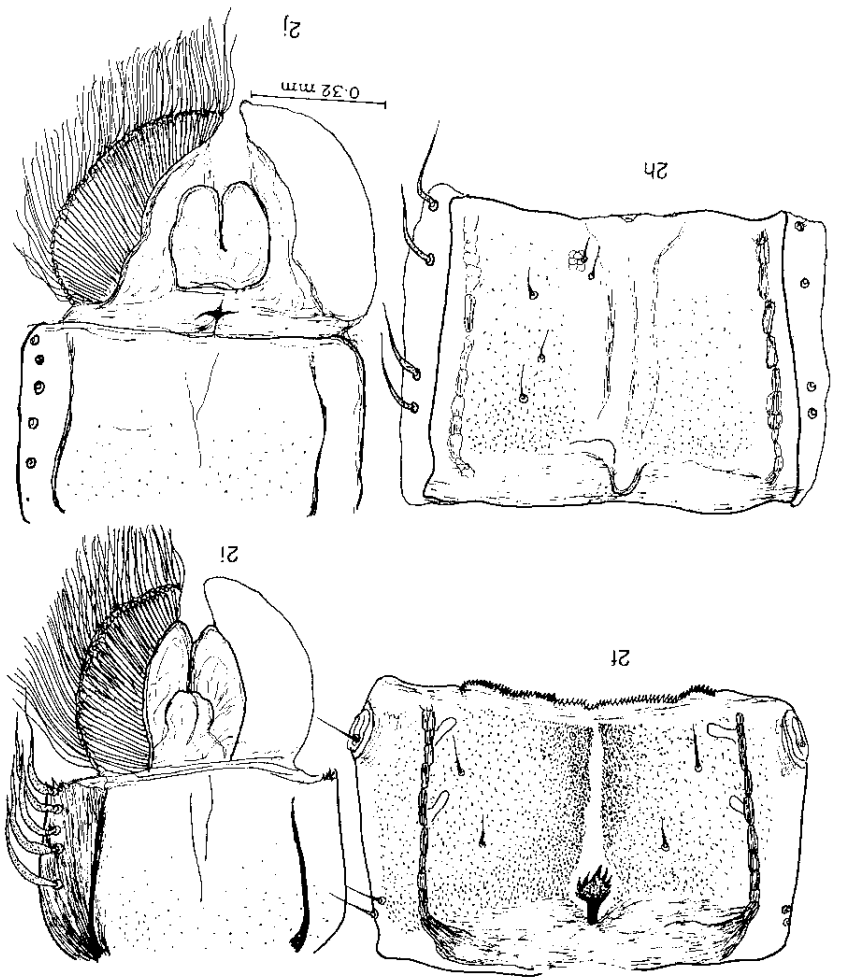


Fig. 2. Pupa of *Glyptotendipes barbipes* (Staeger). a, frontal plate; b, antennal sheath (male); c, antennal sheath (female); d, respiratory organ; e, abdomen; f, abdominal tergite II; g, bunch of spines; h, abdominal tergite VIII; i, genital sac (male) and j, genital sac (female).



broad band of spinules interrupted at the middle, tergite VI with patches of spinules at each basolaterad and caudolaterad, tergite VII with band of spinules at the apical region interrupted at the middle, tergite with median shagreenation interrupted medially, tergites II-V each with a bunch of spines (Fig. 2 g) segments I- VIII each with 5, 4, 3, 3, 3, 3, 2 pairs of segmental setae respectively and 2, 2, 3, 3, 4, 4, 5 pairs of lateral setae respectively of which lateral setae of segments V- VIII are filamentous, segment VIII with unequal pew-like caudolateral spurs (Fig. 2 h) with 4-5 spines one on each side. Anal fin 0.52 (0.43-0.55, n=10) long fringed with filamentous hairs, being biserial at the distal half, no anal macroseta. Genital sac in male (Fig. 2 i) 0.36 (0.32-0.39, n=10) long and in female (Fig. 2 j) 0.25 (0.24-0.27, n=10) long. G/F 0.71 (0.69-0.74) in male and 0.5 (0.48-0.54) in female.

MATERIAL EXAMINED -- Eight males and 6 females, pupae 5 males, 4 females exuvia reared in the laboratory.

IMAGO

MALE -- Length of body 4.41 (3.78-5.14, n=6) length of wing 2.26 (2.14-2.52, n=6) and breadth of wing 0.63 (0.59-0.76, n=5).

Head -- Brown in colour except eyes. Vertex with 24 (22-26) setae in each side. Clypeus with 24 (22-26) setae, clypeal ratio 0.71 (0.67-0.74). Maxillary palp brown, palpomere III with a preapical pit bearing 3 (3-4) sensilla, length ratio of palpomeres I-V 3 : 2.5 : 10 : 10 : 11; L/W 4.5 (4.4-4.6). Eyes bare, hemispherical. Antenna brown, setae longer at base and shortened towards apex; length ratio of flagellomeres I-XI 4 : 3 : 4 : 3 : 2 : 2 : 2 : 2 : 2 : 2 : 75, AR 3.05 (2.5-3.6). Pedicel ratio 0.85 (0.81-0.91). CA 0.53 (0.51-0.54), CP 1.31 (1.22-1.36).

Thorax -- Anteprenotum broad and collar like. Acrostichals 36 (30-36) arranged in double rows, dorsocentrals 56 (54-65) in several rows. Scutellum with 16 (16-17) arranged in two staggered rows, post-scutellum bare.

Wing (Fig. 3 a) -- Smoky. Brachiolum with 4 setae. R with 25 (23-26) setae, R1 with 22-30 (24) and R4+5 with 28-30 (29) setae; r-m dark, and distal to f-cu; An ends proximal to f-cu. Sensory organ 1 or r-m. Squama with 21 setae. CR 0.92 (0.91-0.96), VR 0.92 (0.91-0.92).

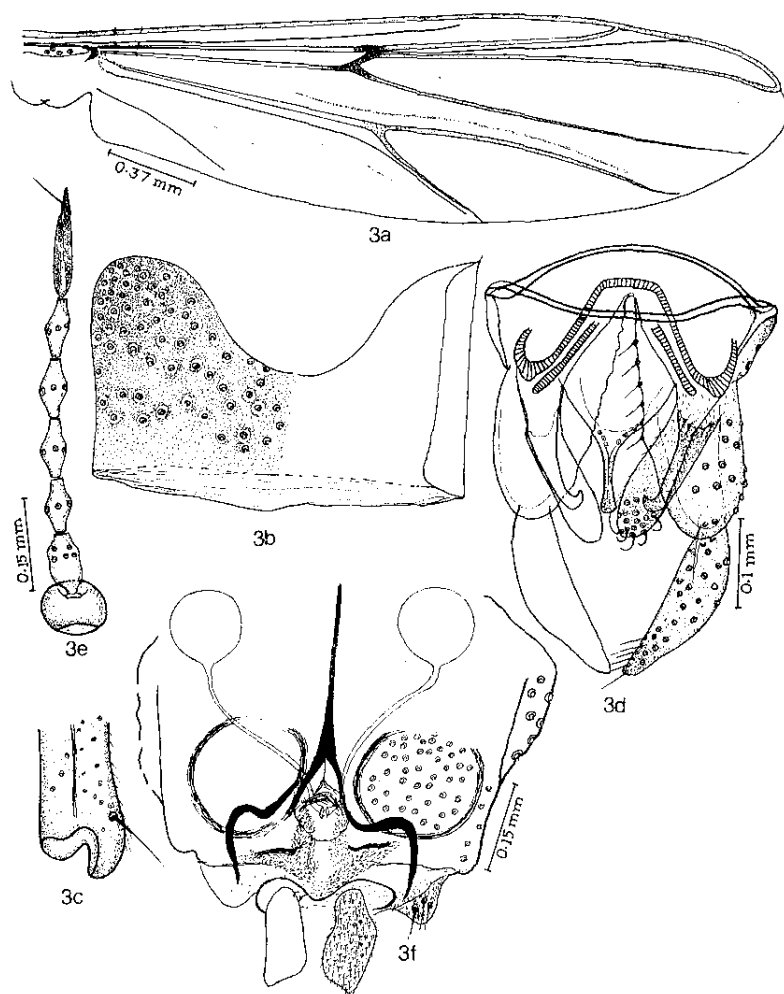


Fig. 3. Imago of *Glyptotendipes barbipes* (Staege). a, wing; b, abdominal tergite I; c, fore tibial scale; d, hypopygium e, antenna (female) and f, genitalia (female).

Legs — Yellow in colour with numerous setae. Fore tibia with blunt scale (Fig. 3 c) bearing 3 long setae. Fore tarsomere I with numerous setae. Tarsomere V of all legs curved, with pointed tip pulvillus well developed with numerous capitate setae.

Proportions and ratios of leg-segments

	Fe	Ti	Ta1	Ta2	Ta3	Ta4	Ta5	LR	SV	BV
Fore	31	27	38	21	18	16	7	1.41	1.36	1.54
Mid	32	31	17	11	10	7	4	0.55	3	2.5
Hind	33	38	25	15	13	9	5	0.66	2.6	2.2

Abdomen — Tergites with pattern as shown in Fig. 3 b.

Hypopygium (Fig. 3 d): anal point well developed with swollen apex and with 3 setae at each basal margin. Gonocoxite stout with 18 (17-19) setae over it; gonostylus dilated bearing 4 (3-4) small setae at its inner apical margin and 15 (12-16) setae over it. Superior volsella bent at the middle hooked; inferior volsella gated, more or less of uniform width bearing 18 (17-24) curved setae at its apex. Transverse sternapodeme 0.07 (0.07-0.08) long, lateral sternapodeme 0.14 (0.13-0.15) long, coxapodeme 0.05 (0.05-0.06) long and phallapodeme 0.06 (0.07-0.11) long. HR 1.41 (1.35-1.49), HV 2.57 (2.52-2.73).

FEMALE

Length of body 6.1 (5.9-6.8, n=7), length of wing 3.0 (2.9-3.2, n=5) and breadth of wing 0.72 (0.70-0.85, n=7).

Similar to male with usual sex differences.

Antenna (Fig. 3 e) yellowish brown, flagellomere VI longest and narrowed towards apex, flagellomere V with a long apical seta, length ratio of flagellomeres I-VI 6 : 6 : 6 : 7 : 5 : 10; AR 0.41 (0.39-0.42, n=5).

Genitalia (Fig. 3 f) — Notum 0.19 (0.18-0.22, n=6) long. Coxosternapodeme stout and bent. Gonopophysis VIII consists of an elongated, more or less pyramidal dorsomesal lobe and a leaf like ventrolateral lobe, apodeme lobe short and bent. Postgenital plate broad with numerous setae. Seminal capsules oval, equal 0.12 (0.12-0.13, n=6) long, ducts of seminal capsules more or less straight.

MATERIAL EXAMINED — Seven males and 5 females (reared in laboratory).

SILK SPINNING

The microscopical examination of the larval tubes of natural habitat showed the presence of silken salivary net on its wall. The method of spinning the net was studied by putting a few glass capillaries (1.5 cm / 0.25 cm) and some larvae in experimental Petri dishes in the laboratory. The dishes contained only water and without any substrate. Immediately after introduction of the larvae, they started up and down movement and got entrance to the capillaries where the worms were observed to set for the action. The anterior parapods were happened to be the chief implements employed and the other structures of the body were also found to be useful for the purpose. The larvae of *Glyptotendipes barbipes* initiated spinning first by fixing its body to the wall of tubules with the help of posterior parapods. It then began spinning by extending its body forward and made several fairly rapid passes in order to touch the capillary wall with the head and the anterior parapods. These movements placed the silk strands to attach the apex of the net. The larvae then withdrew its body and drew out a ribbon of silk spread thereon by the anterior parapods. Soon after completion of the ribbon, the worms retracted the anterior parapods and moved backward quickly. During this action, the prolegs drew certain portion of the silken thread which later became glued to the wall of capillary. The larvae then extended its body to move forward so as to fasten the silk to the wall with the head and rhythmic action of anterior parapods. When the movement came to an end threads were attached to the central point either by contact of mandible, labrum, lateral arms of epipharynx and the legs. The process of rapid backward and slow forward movement were repeated but the attachment of posterior parapods remained as such. After completion of spinning process, the larvae turned about and began drawing water into the net.

The entire process of silk spinning and the formation of net required 1 minute or less.

DISCUSSION

The Holarctic species, *Glyptotendipes barbipes*, was described in adult in the genus *Chironomus* Meigen by STAEGER (1839).

The generic change was made by JOHANNSEN (1905) and since then it has been in use throughout. The reared immature forms and the adults of the species are found to be identical with those described by SUBLETTE and SUBLETTE (1973) with a few minor differences in chaetotaxy and biometries which, in our opinion, should be due to technical errors. The larvae are eutermal and epibelic in habitat and were fetched from a mesotrophic lake of the university campus and also from the rice field nearby the university campus. The larval mentum, antenna and seta subdentalis of mandible exhibit closeness to those of *G. paripes* (Edwards). The general appearance of ventromental plate, claws of posterior parapods seem to have affinities with *G. tokunagai* Sasa (1979). Similarly, *G. lobiferus* (Say) and *G. meridionalis* Dendy and Sublette agree in certain points with the present species in respect to shagreenation on tergites II and VI and caudolateral spur on abdominal segment VIII of pupa. The egg mass of the species appeared same like that of KIMERLE and ANDERSON (1971). However, the larva, pupa and the imagines of *Glyptotendipes barbipes* may be identified from all others by the following combination of characters:

Larva -- a) lanceolate seta subdentalis, b) arrangement of teeth on mentum, c) plate like pecten epipharyngis with 31-32 unequal teeth, d) structure of premento-hypopharyngeal complex and e) details of maxilla.

Pupa -- a) triangular frontal tubercle, b) rugulose thorax, c) shape of bunch of spines on tergites II-VI, d) shagreenation pattern on tergites and e) G/F ratio.

Imago -- a) chaetotaxy of thorax, b) smoky wing, c) well developed anal point and the setae at its basal margin, d) hooked and little bent superior volsella and e) more or less uniform inferior volsella.

From the above study, it appears that the chironomid took 28-35 and 39-46 days to complete its life cycle in summer and winter respectively and any change in the environmental factors was noted affected the development. The method of spinning the silk around the burrow looked similar to that of LEATHERS (1922), but the time required for the same seemed to be a bit higher than the above.

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RESUMO

Ovo, larva, pupa e adultos de *Glyptotendipes barbipes* (Staeger) são registrados e descritos pela primeira vez do Oriente. A espécie era previamente conhecida da Europa e América do Norte. O método de tecelagem da seda pelas larvas é também colocado neste trabalho.

PALAVRAS CHAVE: *Glyptotendipes-barbipes*, Chironomidae, Índia.

SUMMARY

Egg, larva, pupa and the imagnes of *Glyptotendipes barbipes* (Staeger) are first recorded and described from the Orient. The species was previously known from Europe and North America. The method of silk spinning by the larvae in the laboratory is also stated in this paper.

KEY WORDS: *Glyptotendipes-barbipes*, Chironomidae, India.

RÉSUMÉ

Oeuf, larve, pupe et adultes du *Glyptotendipes barbipes* (Staeger) sont registrées et decrites pour la première fois d'Orient. La espèce etait deja connue d'Europe et de l'Amérique du Nord. Le méthode de tissure de la soie pour les larves est aussi décrit.

MOTS CLÉS: *Glyptotendipes-barbipes*, Chironomidae, India.

BIBLIOGRAPHY

- CHAUDHURI, P.K.; S.K. NANDI and M. GHOSH. 1983. Postembryonic stages of *Tanypus bilobatus* (Kieffer) n.comb. (Diptera, Chironomidae) with a note on its biology. *Arch. Hydrobiol.* 97 (1): 122-133.
- EDWARDS, F.W. 1929. British non-biting midges (Diptera: Chironomidae). *Trans. R. ent. Soc. Lond.* 77: 279-430.
- GOETGHEBUER, M. 1937-1954. Tendipedidae (Chironomidae). b.Subfamilie Tendipedinae (Chironominae). A. Die Imagines. In: LINDNER, E. (Ed.), *Die Fliegen der Palaearktischen Region*. 13 c. 138 pp.
- GRODHAUS, G. 1967. Identification of chironomid midges commonly associated with the stabilization of lagoons in California. *Calif. Vector Views* 14: 1-11.
- JOHANNSEN, O.A. 1905. Aquatic nematoceros Diptera. In: NEEDHAM, I.G.; K.I. MORTON and O.A. JOHANNSEN (Eds.). May flies and midges of New York. *Bull. N. Y. St. Mus.* 86: 76- 327.
- KIMERLE, R.A. and N.H. ANDERSON. 1971. Production and bioenergetic role of the midge *Glyptotendipes barbipes* (Staeger) in waste stabilization lagoon. *Limnol. Oceanogr.* 16: 646-659.
- LEATHERS, A.L. 1922. Ecological study of aquatic midges and some related insects with special reference to feeding habits. *Bull. Bur. Fish. Wash.* 38: 1-61.
- SAETHER, O.A. 1980. Glossary of chironomid morphology, terminology (Diptera: Chironomidae). *Ent. Sc and Suppl.* 14. 51 pp.
- SASA, M. 1978. A comparative study of adults and immature stages of nine Japanese species of the genus *Chironomus* (Diptera: Chironomidae). *Res. Rep. Nat. Inst. Environ. Stud.* 3: 1-63.
- SASA, M. 1979. A morphological study of adults and immature stages of 20 Japanese species of the family Chironomidae (Diptera). *Res. Rep. Nat. Inst. Environ. Stud.* 7: 1-148.

STAEGER, C. 1839. Systematisk fortegnelser over dei Denmark hidtil funde Diptera. *Køjer Naturhist. Tidsskr.* 2: 549-600.

SUBLETTE, J.E. and N.S. SUBLETTE. 1973. The morphology of *Glyptotendipes barbipes* (Staeger) (Diptera: Chironomidae). *Stud. Nat. Scien.* 1. 81 pp.

TOWNES, H.K. 1945. The nearctic species of Tendipediini (Diptera: Chironomidae). *Am. Midl. Nat.* 34: 1-206.

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