

## The first record of the subfamily Buchonomyiinae (Diptera: Chironomidae) from Italy

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#### ABSTRACT

Mature female pupae and pupal exuviae of *Buchonomyia thienemanni* were captured from the Taro and Adda rivers in northern Italy in June and July 2002. This is the first record of the subfamily Buchonomyiinae from Italy. The pupae do not substantially differ from those collected in other European localities. New information about the autoecology and geographical distribution of *B. thienemanni* is given. The species, captured in clean, shallow waters with high oxygen content, is rare in Europe, larvae are known from Ireland only, pupal exuviae from nine countries.

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#### INTRODUCTION

The subfamily Buchonomyiinae consists of a single genus *Buchonomyia* which includes three species: the Palearctic *B. thienemanni* Fittkau (1955), the oriental *B. burmanica* Brundin and Sæther (1978) and the neotropical *B. brundini* Andersen and Sæther (1995). A fourth species, *Buchonomyia succinea* spec. nov., has recently been described on the basis of a male specimen from Baltic amber (Seredszus & Wichard, 2002).

The phylogenetic position of the genus has been controversial for a long time, since the pupa is strongly plesiomorphic and the larva was unknown. Fittkau (1955) first placed *Buchonomyia* in the Podonominae, then Brundin (1966) suggested it could be a possible plesiomorph Orthoclaadiinae. Analysing the male genitalia, Brundin & Sæther (1978) erected the subfamily Buchonomyiinae for the genus and stated it to be a sister group of the semifamily Chironominae (Diamesinae + Prodiamesinae + Orthoclaadiinae + Chironominae clade). Murray & Ashe (1981, 1985) suggested the placement of the Buchonomyiinae within the Tanypodinae (Podonominae + Aphroteniinae + Tanypodinae clade) and the discovery of the first-instar larva lacking premandibles posed other phylogenetic questions (Ashe, 1985, 1995). Sæther (1989), although agreeing with some of these findings, retained his interpretation of the placement of the subfamily in Chironominae, on the basis of female genitalia and pupal characters and confirmed it in a recent work (Sæther, 2000).

In June and July 2002 mature pupae and pupal exuviae of *B. thienemanni* were captured in two different rivers (the Adda and the Taro) in northern Italy. The species had been previously found as adults or pupal exuviae in Germany (Fittkau, 1955; Caspers, 1983), Ireland (Murray, 1976; Murray & Ashe, 1981), France (Laville, 1981), England (Murray & Ashe, 1981), Spain (Cobo & González, 1990; Calle Martinez *et al.*, 1995), Belgium (Evrard & Goddeeris, 1995), Luxembourg (Klink, A.

1984; Andersen & Sæther, 1995), Austria (Janecek & Moog, 1995) and Slovakia (Bitusik & Losos, 1997) (Fig. 1).

The hyporheic habitat was supposed to explain the absence of captures of larvae (Pinder, 1995), until Ashe (1995) discovered one associated with a Trichoptera case (see Discussion).

The objective of the present paper is to give new information about the ecological traits (Rosenberg & Resh, 1992) and geographical distribution of *B. thienemanni*. This work also contributes to the revision of the European checklist of macroinvertebrates, which is a useful tool for assessing water quality as recommended by European Framework Directive n. 60/2000/CE.

The Adda is 313 km long and flows in a mainly calcareous, 7979 km<sup>2</sup> river catchment basin, from the southern Alps to the Po river, passing through Lake Como. The specimens were collected in the potamal near the village of Comazzo at 99 m a.s.l., where the Adda has a typically pre-Alpine regime with mean annual flow of 168 m<sup>3</sup> s<sup>-1</sup>, a maximum in June (282 m<sup>3</sup> s<sup>-1</sup>) and a minimum in March (88 m<sup>3</sup> s<sup>-1</sup>). The annual water temperature varies from 5 °C to 22 °C. The river is about 30 m wide and has a gravel substrate. The water velocity is high. The bank is composed of gravel bars.

#### *The Taro river*

The Taro is 125 km long and flows from the northern Apennines to the Po river. The river catchment is 1500 km<sup>2</sup> and is mainly calcareous. The samples were collected about 30 km downstream, in the locality of Compiano, 519 m a.s.l. The Taro river has an irregular river flow which can vary from complete drought upstream to 1000-1800 m<sup>3</sup> s<sup>-1</sup> during floods downstream. The water temperature is comprised between 1 °C and 26.8 °C. The river has a cobble and gravel substrate and is about 15 m wide. The lateral banks are composed mainly of cobblestones and gravel.

## RESULTS

One male pupal exuviae of *B. thienemanni* was collected on 26/VI/2002 in the potamal zone of the Adda. On 3/VII/2002 one female pupal exuviae and on 17/IX/2002 one male pupal exuvia and two mature female pupae were sampled in the upper stretch of the Taro river (Fig. 2).

The general characteristics of the rivers are given in Table I, the environmental variables measured in the sites where *Buchonomyia* occurred are reported in Table II.

Table I. Adda and Taro river characteristics and environmental variables.

<b>River characteristics</b>	<b>Adda</b>	<b>Taro</b>
Hydrographic basin	Po river	Po river
Mediterranean dominium	Alps	Apennines
Flow regime	PreAlpine	Streamy
Mean annual Temperature (°C)	14.7	15.93
Maximum temperature (°C)	22	26.8
Minimum temperature (°C)	5	1
Mean annual pH	7.44	7.98
Mean annual Oxygen (mg l <sup>-1</sup> )	8.8	10.23
Mean annual Conductivity (µS cm <sup>-1</sup> )	318.5	327
Mean annual Ammonium N-NH <sub>4</sub> <sup>+</sup> (mg l <sup>-1</sup> )	-	0.06
Mean annual Nitrate N-NO <sub>3</sub> <sup>-</sup> (mg l <sup>-1</sup> )	-	0.17
Mean annual Phosphate P-PO <sub>4</sub> <sup>3-</sup> (mg l <sup>-1</sup> )	-	0.08
Mean annual Total coliform (MPN) <sup>a</sup>	-	613
Mean annual Fecal coliform (MPN) <sup>a</sup>	-	332

<sup>a</sup>MPN= Most Probable Number (most probable number of coliform present in 100 ml of analyzed water)

Fig. 1 - Revised geographical distribution of *B. thienemanni*.



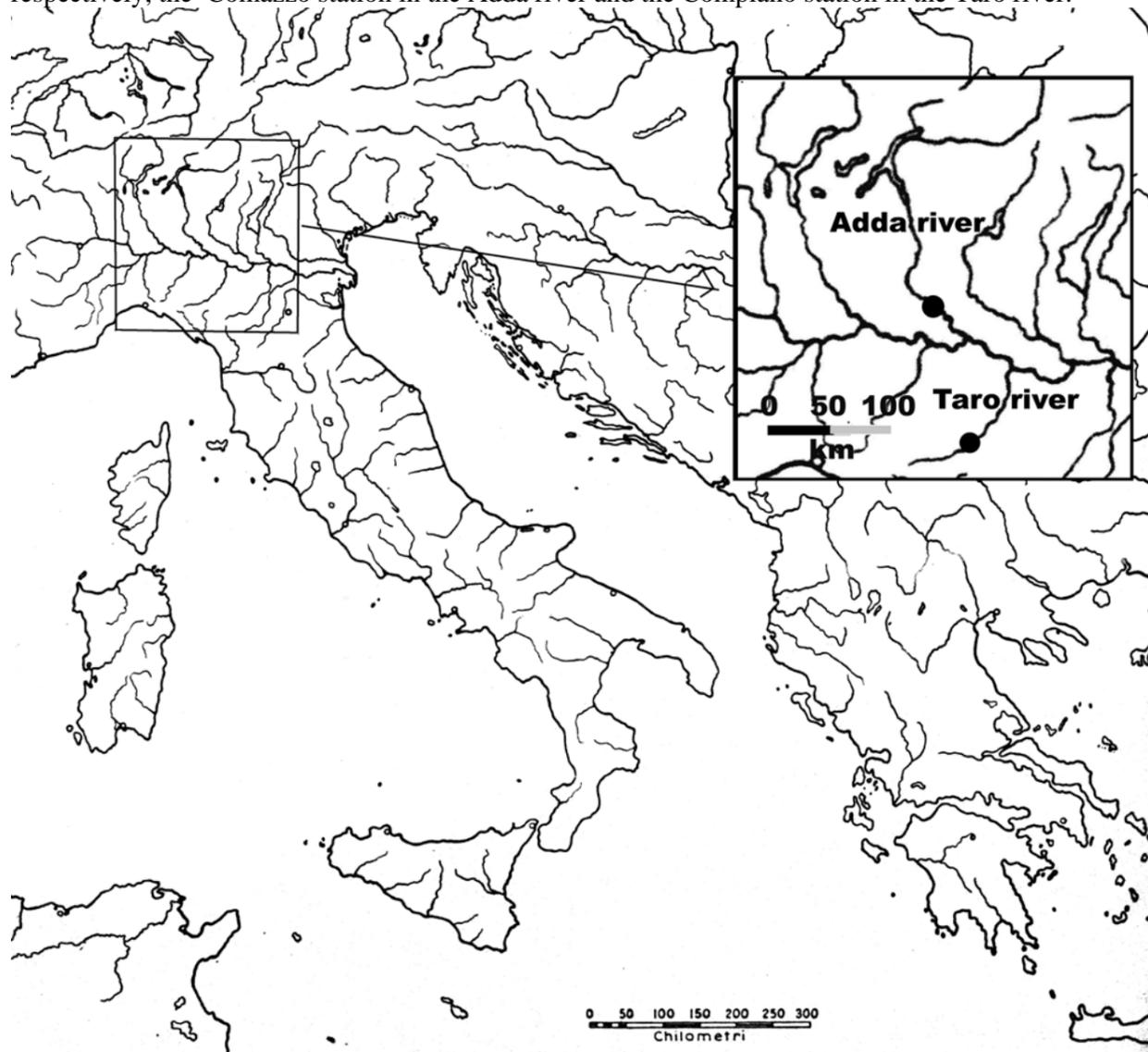
#### METHODS AND STUDY AREA

Macroinvertebrates were sampled monthly during 2001 and 2002 in the Adda and Taro rivers and the following physical and chemical variables were measured: water and air temperature, dissolved oxygen, pH, conductivity, ammonia, P-orthophosphate, N-nitrate and overall and fecal coliform.

The specimens were captured with drift nets, preserved in 70% alcohol and slide mounted in Canada Balsam. The general morphology and terminology follows Sæther (1971).

*The Adda river*

Fig. 2 - Sampling sites in Italy where *B. thienemanni* occurred. The black circles represent, respectively, the Comazzo station in the Adda river and the Compiano station in the Taro river.



*Site characteristics*

*Morphology of the pupa*

The pupa was described by Murray & Ashe (1981) and Wiederholm (1986) (Fig. 3).

In the specimens collected in Italy the arrangement of the abdominal lateral setae (LS) is the following: segment II with 1 robust anterior, 1 robust posterior and 1 slender posterior seta, segments III-V with 1 robust anterior and 1 posterior, segments VI-VII with 2 posterior and segment VIII with 1 robust posterior seta. Pedes spurii A absent. In the apical part of abdominal segments a very fine shagreen is observed. The exuviae is heavily sclerotised, the colour is dark brown in the male and light brown in the female. In all specimens the head is lacking.

Table II. Site characteristics and environmental variables at Comazzo (Adda river) and Compiano (Taro river) on the sampling dates.

Site characteristics	Adda		Taro	
	(Comazzo)		(Compiano)	
Sampling date	26/VI/2002	3/VII/2002	17/IX/2002	
Number of collected specimens	1 male exuvia	1 female exuvia	1 male exuvia	2 female pupae
Longitudinal distribution	Epipotamon	Metarhithron	Metarhithron	
Geomorphology	Alluvial deposits	Alluvial cone	Alluvial cone	
Altitude (m a.s.l.)	99	519	519	
Substratum	Gravel	Cobbles-gravel	Cobbles-gravel	
Water depth (cm)	90	60	65	
Current (> 50 cm s <sup>-1</sup> )	Fast	Fast	Fast	
Temperature (°C)	20.5	18.8	17.3	
pH	7.5	7.8	8.02	
Oxygen (mg l <sup>-1</sup> )	9	9.2	9.7	
Conductivity (µS cm <sup>-1</sup> )	279	315	295	
Ammonium N-NH <sub>4</sub> <sup>+</sup> (mg l <sup>-1</sup> )	-	0.04	0.07	
Nitrate N-NO <sub>3</sub> <sup>-</sup> (mg l <sup>-1</sup> )	-	0.14	0.44	
Phosphate P-PO <sub>4</sub> <sup>3-</sup> (mg l <sup>-1</sup> )	-	0.015	0.090	
Total coliform (MPN) <sup>a</sup>	-	920	1,600	
Fecal coliform (MPN) <sup>a</sup>	-	920	920	

<sup>a</sup>MPN = Most Probable Number (most probable number of coliform present in 100 ml of analyzed water)

#### *Morphology of the female imago*

The female imago was described by Sæther (1977). Our specimens are in agreement with that description.

#### DISCUSSION

This is the first record of the subfamily Buchonomyiinae from Italy.

#### *Morphology and geographical distribution*

Our specimens differ from previous descriptions in the arrangement of the lateral setae. The different colour of the male and female exuviae is an expression of sexual dimorphism in the pupae, and the lack of the head in all the obtained pupal exuviae suggests the hypothesis of a particular type of emergence, which could imply the detachment of the cephalic part of the exuviae. To confirm this conclusion more specimens will have to be examined.

*B. thienemanni* is the only species of the subfamily Buchonomyiinae known from the Palaearctic. Prior to this investigation, pupal exuviae had been obtained from rivers in central Europe, from Ireland to the Bavarian Alps. The larva was collected in Ireland (Ashe, 1985, 1995).

*B. thienemanni* was found also in Spain both in the Ulla river, Galizia (Calle Martinez *et al.*, 1995) and in the Guadalquivir, Andalusia (Cobo & Gonzáles, 1990). It is evident that the species has colonized the Mediterranean region (Fig. 1): the capture in the Taro and Adda is the first evidence of its presence in tributaries of the Po river, which flows into the Mediterranean Sea. However the species is quite rare in southern Europe, representing at most 1% of the total Chironomids collected in each sampling.

Fig. 3 – Slide mounted pupal exuviae of *B. thienemanni* collected in the Adda river (Comazzo) on 26/VI/2002.



### *Biology and ecology*

The specimens were captured from late June to September, confirming that the species is a univoltine summer-emerging one (Murray & Ashe, 1981; Caspers, 1983).

The distribution of *B. thienemanni* had suggested in the past the hypothesis of a cold-stenothermal species (Fittkau, 1955) because the maximum water temperature reported was 16 °C (Murray & Ashe, 1981). The occurrence of the species in Spain (Cobo & González, 1990) and in Italy in stretches with a water temperature (Table II) up to 20 °C does not support this statement. The warmer climate in the Mediterranean region probably determines an earlier emergence of the adults.

*B. thienemanni* occurs both in the rhithral and in the potamal (Table II), in presence of a cobble-gravel (Ashe, 1995) or a soft sandy substrate (Caspers, 1983; Andersen & Sæther, 1995); it has been captured in rivers with a very different discharge, from Ireland through the Alps to the Apennines, occurring in a wide range of environmental conditions. The species colonizes mainly shallow waters (Fittkau, 1955; Ashe, 1995) with high oxygen concentrations (7.5-9.7 mg/l) and avoids lentic habitats.

The values of measured chemical variables show that both rivers are moderately polluted: the E.B.I. Quality Class (Ghetti, 1986) is III-II in the Adda and II in the Taro, ammonia and total coliform concentrations are higher than the Water Quality Standards envisaged by Italian law (D.L. 152/99, modif. 248/2000). *B. thienemanni* was found in oligotrophic waters according to Cobo & González (1990) and Janecek & Moog (1995) considered the species an indicator of a  $\beta$ -mesosaprobic zone.

Ashe (1995) discovered in the River Flesk (Ireland) a third-instar larva in a case probably constructed by a trichopteran.. This suggested that *B. thienemanni* could live in a commensal, parasitic or predatory association. This is supported by the presence of *Hydropsyche pellucidula* (Curtis) and *Cheumatopsyche lepida* (Pictet) in the Flesk, Adda and Taro rivers, where *B. thienemanni* was captured.

### REFERENCES

- Andersen T., Sæther O.A., 1995 - The first record of *Buchonomyia* Fittkau and the subfamily Buchonomyiinae from the New World (Diptera: Chironomidae). In: P. Cranston (ed.), Chironomids: from Genes to Ecosystems. CSIRO, Melbourne, pp. 363-367.
- Ashe P., 1985 - A larval diagnosis for the subfamily Buchonomyiinae and the genus *Buchonomyia* with a description of the 1<sup>st</sup> instar larva of *Buchonomyia thienemanni* Fitt. (Diptera: Chironomidae). Spixiana Suppl., 11: 143-148.
- Ashe P., 1995 - Description of a late-instar larva of *Buchonomyia thienemanni* Fittkau and further data on its ecology with diagnoses for the subfamily Buchonomyiinae and genus *Buchonomyia* (Diptera: Chironomidae). In: P. Cranston (ed.), Chironomids: from Genes to Ecosystems. CSIRO, Melbourne, pp. 425-429.
- Bitusik, P., Losos, B., 1997 - Chironomidae. In: M. Chvla (ed.), Check List of Diptera (Insecta) of the Czech and Slovak Republics. Karolinum, Charles University Press, Prague, pp. 34-39.
- Brundin L., 1966 - Transantarctic relationships and their significance, as evidenced by chironomid midges with a monograph of the Podonominae and Aphroteniinae subfamilies and the austral Heptagyiidae. K. Svensk. Vetensk. Handl., 11: 1-472.
- Brundin L., Sæther O.A., 1978 - *Buchonomyia burmanica* sp. n. and Buchonomyiinae, a new subfamily among the Chironomidae (Diptera). Zool. Scr., 7: 269-275.
- Calle Martinez D., Vilchez Quero A., Casas Jimenez J.J., 1995 - Chironomids (Diptera) of the Upper-Guadalquivir (Sierra de Cazorla, Southern Spain). Ann. Limnol., 31(3): 201-213.
- Caspers N., 1983 - Die Chironomiden der Oberen Alz (Diptera, Nematocera). Nachrichtenbl. Bayer. Entomol., 32: 97-108.
- Cobo F., González M.A., 1990 - Las comunidades de quironómidos (Diptera: Chironomidae) del río Ulla (NW de España). Limnetica, 6: 109-118.

- Evrard M., Goddeeris B., 1995 - Notes on the presence of a subfamily of Chironomidae (Diptera) new to the fauna of Belgium. *Bull. Soc. R. Belge Entomol.*, 131: 493-498.
- Fittkau E.J., 1955 - *Buchonomyia thienemanni* n. gen. n. sp. Chironomidenstudien IV (Diptera; Chironomidae). *Beitr. Entomol.*, 5: 403-414.
- Ghetti P.F., 1986 - Macroinvertebrates in the quality analysis of water courses. Provincia Autonoma di Trento, Trento, 111 pp.
- Janecek B.F.U., Moog O., 1995 – Diptera: chironomidae. Subfamily Buchonomyiinae. *In*: O. Moog (ed.), *Fauna Aquatica Austriaca. A comprehensive species inventory of Austrian aquatic organisms with ecological notes.* Bundesministerium für Land- und Forstwirtschaft, Vienna, Part IIIB p.1, Part IIIC p.1.
- Klink, A. 1984. Studie over de toepasbaarheid van palaeolimnologisch onderzoek in riviersedimenten. Een middel om biologische beoordeeling van rivieren te onderbouwen?. (Study on the applicability of palaeontological investigation in river sediments. A means to support the biological evaluation of rivers ?). *Rapp. Meded. Hydrobiol. Adviesbur.* 7: 27-38.
- Laville H., 1981 - Récoltes d'exuvies nymphales de Chironomides (Diptera) dans le Haut-Lot, de la source (1295 m), au confluent de la Truyère (223 m). *Annls. Limnol.*, 17: 255-289.
- Murray D.A., 1976 - *Buchonomyia thienemanni* Fittkau (Diptera, chironomidae), a rare and unusual species recorded from Killarney, Ireland. *Entomol. Gaz.*, 27: 179-180.
- Murray D.A., Ashe P., 1981 - A description of the pupa of *Buchonomyia thienemanni* Fittkau, with notes on its ecology and of the phylogenetic position of the Buchonomyiinae subfamily (Diptera, Chironomidae). *Spixiana*, 4: 55-68.
- Murray D.A., Ashe P., 1985 - A description of the adult female of *Buchonomyia thienemanni* Fittkau and a reassessment of the phylogenetic position of the Buchonomyiinae subfamily. *Spixiana Suppl.*, 11: 149-160.
- Pinder L.C.V., 1995 – The habitats of chironomid larvae. *In*: P. Armitage, P.S. Cranston & L.C.V. Pinder (eds.), *The Chironomidae. The biology and ecology of non-biting midges.* Chapman & Hall, London, pp. 107-135.
- Rosenberg D.M., Resh V.H., 1992 - Freshwater biomonitoring and benthic macroinvertebrates. Chapman & Hall, London, 625 pp.
- Sæther O.A., 1971 - Notes on the general morphology and terminology of the Chironomidae (Diptera). *Can. Entomol.*, 103: 1237-1260.
- Sæther O.A., 1977 - Female genitalia in Chironomidae and other Nematocera: morphology, phylogenies, keys. *Bull. Fish. Res. Bd. Canada*, 197: 1-210.
- Sæther O.A., 1989 – Phylogenetic trends and their evaluation in chironomids with special reference to orthoclads. *Acta Biol. Debr. Oecol. Hung. Suppl.*, 2: 53-75.
- Sæther O.A., 2000 – Phylogeny of the subfamilies of Chironomidae. *Syst. Entomol.*, 25: 393-403.
- Seredzus F., Wichard W., 2002 – Buchonomyiinae (Diptera, Chironomidae) in Baltic Amber. *Stud. Dipterol.*, 9: 2, 393-402.
- Wiederholm T., 1986 - Chironomidae of the Holartic Region, part 2. Pupae. *Ent. Scand. Suppl.*, 28: 1-482.