

**DISTRIBUTION AND RELATIVE DENSITY
OF THREE SANDFLY (*DIPTERA: PHLEBOTOMINAE*) SPECIES
IN SOUTHERN SWITZERLAND**

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SUMMARY. Sticky paper traps were used to demonstrate the presence of three sandfly species—*Phlebotomus (Larroussius) perniciosus* (Newstead 1911), *Phlebotomus (Adlerius) mascittii* (Grassi 1908) and *Sergentomyia (Sergentomyia) minuta* (Rondani 1843)—in canton Ticino (southern Switzerland) from 1981 to 1983. Some concentrations of *P. perniciosus* and *S. minuta* were noted in western Mendrisioto and minor Malcantone. Studies on the vertical distributions of sandflies showed *S. minuta* at 200-600 m, *P. perniciosus* at 300-600 m and *P. mascittii* at 400-700 m above sea level. When modified CDC light traps were used in certain biotopes, improved catches of *P. perniciosus* and *P. mascittii* were recorded.

Key-words: Phlebotominae. Distribution. Switzerland.

Distribution et densité relative de trois espèces de phlébotomes (*Diptera: Phlebotominae*) en Suisse méridionale

RÉSUMÉ. Des piégeages réalisés en Suisse méridionale (Tessin) avec la méthode du papier adhésif ont mis en évidence la présence de trois espèces de Phlébotomes, *Phlebotomus perniciosus* (Newstead 1911), *Phlebotomus mascittii* (Grassi 1908) et *Sergentomyia minuta* (Rondani 1843). La distribution horizontale se révèle basse et relativement régulière. Dans deux régions toutefois, l'ouest du Mendrisioto et le bas du Malcantone, une densité moyenne à haute est observée. La distribution verticale montre que *P. perniciosus* est présent aux altitudes moyennes (300-600 m), *P. mascittii* en haute altitude (400-700 m) alors que *S. minuta* se trouve partout (200-600 m), jusqu'à de très basses altitudes. Les pièges lumineux capturent un beaucoup plus haut nombre de Phlébotomes des espèces *P. perniciosus* et *P. mascittii* que les pièges à papier adhésif, mais ceci dans certains biotopes seulement.

Mots-clés: Phlebotominae. Écologie. Distribution. Suisse.

Introduction

Galli-Valerio (1912) documented the first catch of two female sandflies in western Switzerland, which he identified as *Phlebotomus papatasi* (Scopoli 1786) and which were later shown by Gaschen (1956a) to belong to the species *Phlebotomus mascittii* (Grassi 1908). Vogel (1931) reported the capture of one female

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sandfly in southern Switzerland near Lugano, which he also assigned to the species *P. papatasi* without a careful examination under the light microscope, but this report should be regarded with caution. No further sandflies were caught in Switzerland until 1944 when a few specimens from Ascona in canton Ticino (southern Switzerland) were assigned to: *Phlebotomus perniciosus* (Newstead 1911) and *Phlebotomus parroti* (Adler and Theodor 1927) (Gaschen 1945). The latter have since been identified as *Sergentomyia minuta* (Rondani 1843) by Theodor (1958). Subsequently Gaschen (1956b) published the last report on sandflies which were caught in Switzerland, which described two males and three females of the species *P. perniciosus* and one female of *P. mascittii*. All of these six sandflies were collected in southern Switzerland at Lugano. On the basis of these observations it was of interest to investigate in more detail the sandflies in Switzerland because until now no studies of their biology have been carried out.

Materials and methods

STUDY AREA

Before this work, the few sandflies discovered in Switzerland were mostly caught in southern Switzerland, in the south of the canton Ticino. This part of Switzerland was therefore chosen for these studies which were conducted from 1981 till 1983 in the Sopraceneri and the Sottoceneri (Fig. 1). The north slope of the Magadino plain was fixed as northern boundary.

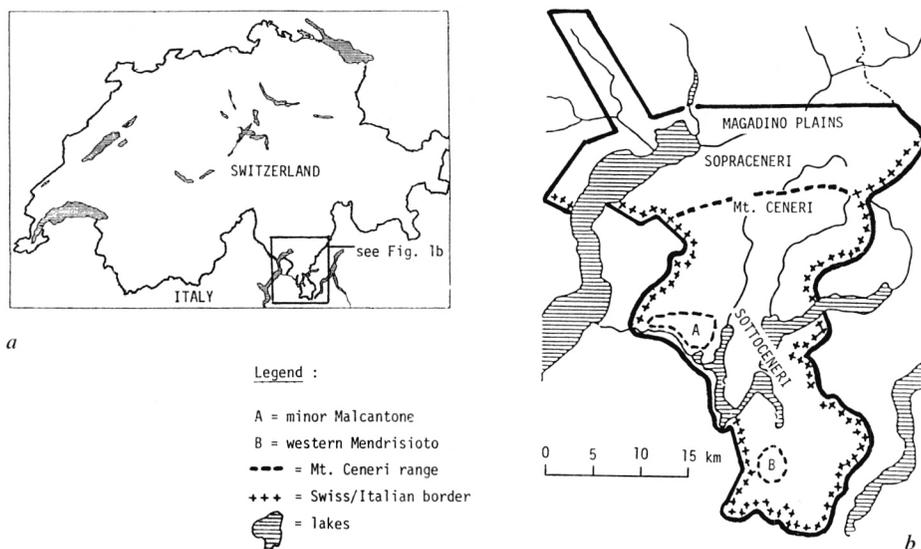


FIG. 1. — Study area in the southern Ticino.

a) Showing location of study area in Switzerland ; b) Study area divided into Sopra- and Sottoceneri by Mt. Ceneri range.

SAMPLING METHODS

Two capture methods were used: firstly, sandflies were caught with sticky paper traps (Rioux *et al.* 1967) which were removed and renewed every 5 days. Secondly, light traps were used at two stations (38 and 41) in different ecological niches. The modified CDC light trap of Smith and Downs (1970) served as the model for these traps and details of the construction are given by Knechtli (1987).

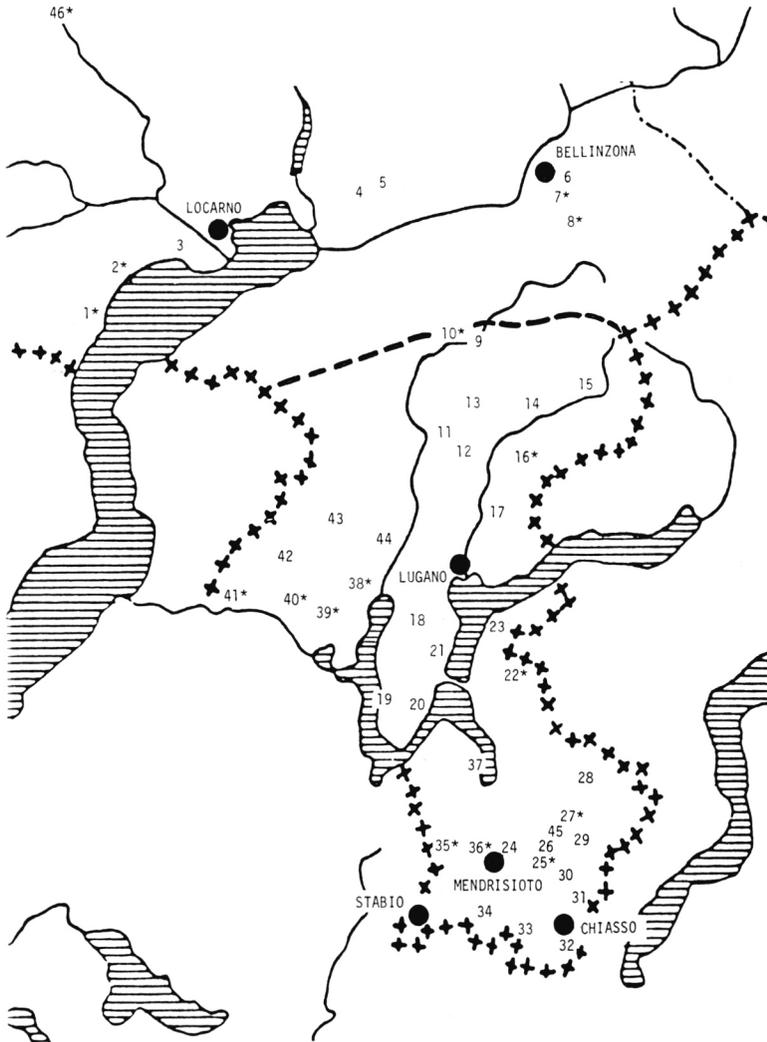
STATIONS IN THE FIELD (*Fig. 2*)

FIG. 2. — Distribution of the 46 stations in southern Ticino.
(* = sites positive for one or more species of sandflies).

In 1981 sticky paper traps were used to catch sandflies at 46 sites in habitats regarded as suitable for sandflies, taking into account their orientation, vegetation and subsoil. At all stations sticky papers were set up in drain holes in the walls to allow a better comparison of the capture-data from previous studies (Croset *et al.* 1977). To compare capture-data at the different stations the number of sandflies per square metre of sticky paper surface was calculated for each station. The numbers were classified to correspond to the density index used in Italy (Biocca *et al.* 1977, WHO 1979), shown in *Table I.*

TABLE I. — Classification of density index
(after Biocca *et al.* 1977 and WHO 1979).

Density per m ² sticky paper	Density index
lower than 8	species present
between 8 and 32	medium density
more than 32	high density

LIGHT TRAP STATIONS

In 1982 and 1983 light traps were set up in the following biotopes of station 38:

Biotope I: Basement of an old, inhabited house of stones. The room is renovated and used today as a laundry and hobbyroom. Its floor is made of concrete and the walls were freshly whitewashed and painted.

Biotope II: Garden in front of biotope I with ornamental plants, vines and a large area of grass.

Biotope III: Two vaults in the retaining wall on a street. Each of them had a small opening and inside was a large amount of dust.

Biotope IV: A roofed chicken-run above the retaining wall mentioned in biotope III.

Light traps were set up in 1983 within the following biotopes of station 41:

Biotope V: Old, disused cowshed with a wet loam floor and a rotten wooden ceiling. The shed contained the wooden mangers which were filled with sandy humus.

Biotope VI: Open area within a granary opposite to biotope V.

Biotope VII: Former cowshed, which had been remodelled and renovated. The floor consisted of cobbled pavement and the walls were freshly whitewashed.

Results

DIVERSITY OF SPECIES

All sandflies caught from 1981 to 1983 in Ticino could be assigned to the three species, *Phlebotomus (Larroussius) perniciosus* Newstead, 1911, *Phlebotomus (Adlerius) mascittii* Grassi, 1908, *Sergentomyia (Sergentomyia) minuta*, Rondani, 1843.

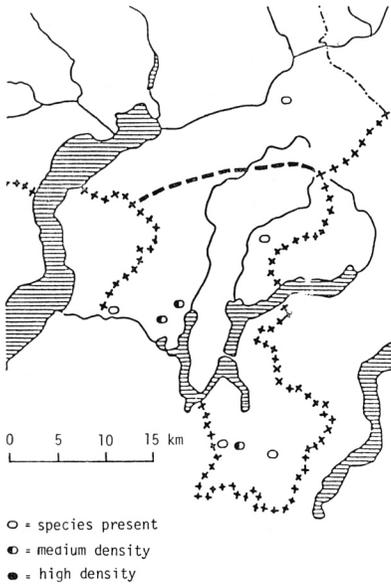


FIG. 3. — Distribution and density of *P. perniciosus* in southern Ticino.

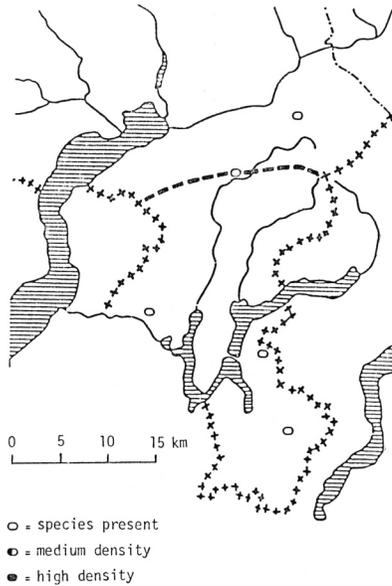


FIG. 4. — Distribution and density of *P. mascittii* in southern Ticino.

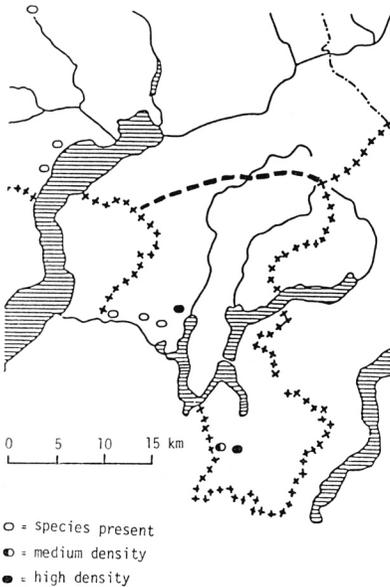


FIG. 5. — Distribution and density of *S. minuta* in southern Ticino.

HORIZONTAL DISTRIBUTION AND DENSITY

Sandflies were caught with sticky papers at 16 of the 46 stations (*Table II*) and were slightly concentrated in two regions, the western Mendrisioto and the minor Malcantone (*Fig. 1*). *P. perniciosus* was never found in high density, was in medium density in western Mendrisioto and minor Malcantone and was mainly found in the Sottoceneri (*Fig. 3*). *P. mascittii* was only ever caught in small numbers (*Fig. 4*) and was mainly present in the Sottoceneri. In contrast *S. minuta* was showed similar concentrations as *P. perniciosus* and was also found in the north of the Monte Ceneri. This species was only discovered in the western parts of the study area, and was found in high density in western Mendrisioto and minor Malcantone (*Fig. 5*).

TABLE II. — Total of capture-data of three surveys in 1981 using sticky papers.

Station	Altitude (in m)	Surface of the sticky papers (in m ²)	<i>Phlebotominae</i>		<i>P. perniciosus</i>		<i>P. mascittii</i>		<i>S minuta</i>	
			number	density per m ²	number	density per m ²	number	density per m ²	number	density per m ²
1	257.5	1.20	2	1.67	.	.	.	.	2	1.67
2	336.5	1.08	1	0.93	.	.	.	.	1	0.93
7	322	0.88	1	1.14	1	1.44	.	.	.	.
8	502.5	1.20	3	2.50	.	.	3	2.50	.	.
10	600	1.20	1	0.83	.	.	1	0.83	.	.
16	573	0.96	1	1.04	1	1.04	.	.	.	.
22	601	0.60	2	3.33	.	.	2	3.33	.	.
25	503.5	0.48	1	2.08	1	2.08	.	.	.	.
27	630	0.96	1	1.04	.	.	1	1.04	.	.
35	500	0.72	16	22.22	1	1.39	.	.	15	20.83
36	359	1.16	90	77.59	10	8.62	.	.	80	68.97
38*	547.5	1.08	91	84.26	9	8.33	.	.	82	75.93
39	432	1.04	14	13.46	13	12.50	.	.	1	0.96
40*	402.5	1.00	4	4.00	.	.	1	1.00	3	3.00
41	380	1.08	6	5.56	2	1.85	.	.	4	3.70
46	370	0.88	4	4.55	.	.	.	.	4	4.55

* = Chosen sites for light trapping in 1982 and 1983. Compare with *Tables III* and *IV*.

VERTICAL DISTRIBUTION

P. perniciosus was discovered between 300 and 600 m above sea level and was most abundant at an altitude of 400 to 500 m. *P. mascittii* was collected between 400 and 700 m, the density of this species increased with altitude. In addition *P. mascittii* was the only species which was detected at an altitude of 600 to 700 m above sea level. Between 200 and 300 m only *S. minuta* was found, but its vertical range extended to 600 m.

CAPTURE-DATA WITH LIGHT TRAPS

The number of sandflies of the species *P. perniciosus* and *P. mascittii* caught using light traps at biotopes I, III, V and VII was greater than the number caught using sticky papers; all of these four biotopes were almost closed rooms. Further *P. perniciosus* was also caught in relatively high numbers in biotope VI whereas in biotopes II and IV sandflies were only observed sporadically.

From the capture-data (*Tables III, IV*) it is clear that in total, very few sandflies of the species *S. minuta* were caught as compared to the species *P. perniciosus* and *P. mascittii*.

TABLE III. — Capture-data with light traps in the biotopes I-IV in 1982.

Biotope	Number of capture-nights	<i>P. perniciosus</i>			<i>P. mascittii</i>			<i>S. minuta</i>		
		♀	♂	Total	♀	♂	Total	♀	♂	Total
Site 38										
I	15	8	6	14	10	—	10	—	—	—
II	15	1	—	1	—	—	—	—	—	—
III	18	9	12	21	1	—	1	2	2	4
IV	18	1	1	2	—	—	—	—	—	—
Total	66	19	19	38	11	—	11	2	2	4

TABLE IV. — Capture-data with light traps in the biotopes I-VII in 1983.

Biotope	Number of capture-nights	<i>P. perniciosus</i>			<i>P. mascittii</i>			<i>S. minuta</i>		
		♀	♂	Total	♀	♂	Total	♀	♂	Total
Site 38										
I	20	6	4	10	8	—	8	1	1	2
II	20	1	—	1	—	—	—	—	—	—
III	20	14	16	30	2	1	3	3	1	4
IV	20	1	2	3	1	—	1	—	—	—
Total	80	22	22	44	11	1	12	4	2	6
Site 40										
V	20	20	9	29	28	4	32	—	—	—
VI	20	12	3	15	—	—	—	1	—	1
VII	20	5	16	21	7	—	7	1	—	1
Total	60	37	28	65	35	4	39	2	—	2

Discussion

STUDY AREA

The climate of Ticino is distinguished by warm and relatively humid air, high mean temperature, a high number of hours of sunshine (Bär 1976) and heavy showers all more typical of the mediterranean (Etter 1963, Bär 1976). The flora is also mediterranean (Neef 1974, Bär 1976), and these are particularly ideal conditions for the occurrence of sandflies.

DIVERSITY OF SPECIES

All the sandflies which were caught could be assigned to the three species *P. perniciosus*, *P. mascittii* and *S. minuta*. The occurrence of these species in Switzerland was previously described by Gaschen (1945, 1956b) on the basis of a few specimens. Even though more sandflies were caught in this study, no additional species for Switzerland were discovered. However, for the first time, females of *S. minuta* and males of *P. mascittii* were caught with sticky papers and light traps respectively.

All of the three species caught in the present study are within the geographical ranges previously described; *P. mascittii* has been previously recorded from southern Italy, southern Sardinia and northern France (Biocca *et al.* 1977; Larrousse 1923, Langeron and Nitzulescu 1931, Callot 1950), *P. perniciosus* from northern Italy and northern France (Biocca *et al.* 1977; Foley 1923, 1924, Langeron and Nitzulescu 1932, Le Gac 1936, Colas-Belcour and Romana 1939, Ristorcelli 1939, Lavier and Ristorcelli 1940) and *S. minuta* from northern Italy and coastal mediterranean France (Biocca *et al.* 1977; Rioux *et al.* 1969). The present results show that the distribution of *S. minuta* can be continental, and present the northern-most European record of this species.

In neighbouring Italy, the above three species plus five others (*Phlebotomus perfiliewi*, *Phlebotomus ariasi*, *Phlebotomus major*, *Phlebotomus papatasi* and *Phlebotomus sergenti*) have been trapped (Biocca *et al.* 1977). From the ranges recorded in the literature for *P. perfiliewi* (found in high density near Milan) and *P. ariasi* (north to Department Sarthe, France, and east to Liguria, Italy) by Houin and Beaucournu (1966) and Biocca *et al.* (1977), it was expected that these species could also be present in southern Switzerland.

HORIZONTAL DISTRIBUTION

At most collection sites only the presence of species could be established although sandflies were caught in medium to high density at a few sites. The numbers collected decreased from south to north Ticino, suggesting that this region represents a northern limit with regard to the spread of sandflies. In parti-

cular, the Monte Ceneri mountain range divides Ticino in northern Sopraceneri and southern Sottoceneri, and seems to be an important barrier as *P. perniciosus* and *P. mascittii* were mainly found in Sottoceneri.

This could be due to the better climatic conditions found in Sottoceneri which is less exposed to the influence of the Alps, having higher minimum and maximum temperatures (Bär 1976, Swiss Meteorological Institute personal communication), an extremely small number of foggy days, and a very high number of sunshine hours (Mörikofer 1947). Furthermore, the increased density of sandflies in western Mendrisioto and minor Malcantone than in the remaining Sottoceneri may be due to the topography of the region; Mendrisioto and minor Malcantone are both hilly regions with maximum altitudes of 617 and 813 m respectively, while the eastern parts of Sottoceneri are mountainous with deep valleys, sharp slopes and altitudes reaching 1,816 m.

A few specimens of *S. minuta* were found in the Sopraceneri. It now seems that drain holes represent optimal biological niches for this species, so it is possible that *S. minuta* may also be found in regions with less ideal climatic conditions and be protected in a biological niche which provides a very steady temperature and humidity. In addition such conditions are also favoured by the lizard *Lacerta muralis* (Laurenti), which is the main host of *S. minuta* (Rioux *et al.* 1969). The apparent densities of the three species in southern Switzerland are approximately equivalent to those in Italy: *S. minuta* was caught in the greatest number of all sandfly species in Italy (Biocca *et al.* 1977) and was similarly found in minor Malcantone and western Mendrisioto at a high density. *P. perniciosus*, the second most frequently caught species in Italy (Biocca *et al.* 1977), was likewise found in west Sottoceneri at medium density. *P. mascittii*, which was very rarely caught in Italy was only detected in Ticino.

VERTICAL DISTRIBUTION

The upper altitude limit for *P. perniciosus* in Ticino was 573 m, approximately the same as in France (eastern Pyrenees, 640 m; Epinouse mountains, 440 m; Cevennes mountains, 600 m) (Croset 1969, Rioux *et al.* 1969), but considerably lower than in Spain (1,750 m) (Ubeda-Ontiveros 1978) and Italy (1,087 m) (Sarca 1949, Corradetti 1962, Biocca *et al.* 1977). The vegetation in Ticino is already alpine at 573 m and is unsuitable for sandflies, compared to more favourable conditions at higher altitudes further south in Italy and Spain. The decreased upper limit for *P. perniciosus* in France has not yet been explained. For *P. mascittii* the picture is similar but is not so obvious as for *P. perniciosus*. *P. mascittii* was found up to 865 m in Italy higher than in southern France (620 m) and Switzerland (630 m). Moreover, in Ticino, this species was found in higher regions than *P. perniciosus* and *S. minuta*. In contrast to *P. perniciosus* and *P. mascittii*, *S. minuta* was found at higher altitudes in southern France (850 m) than in Switzerland (547 m). It appears that *S. minuta* requires a milder climate, which is found in the mediterranean region at a higher altitude than in Ticino.

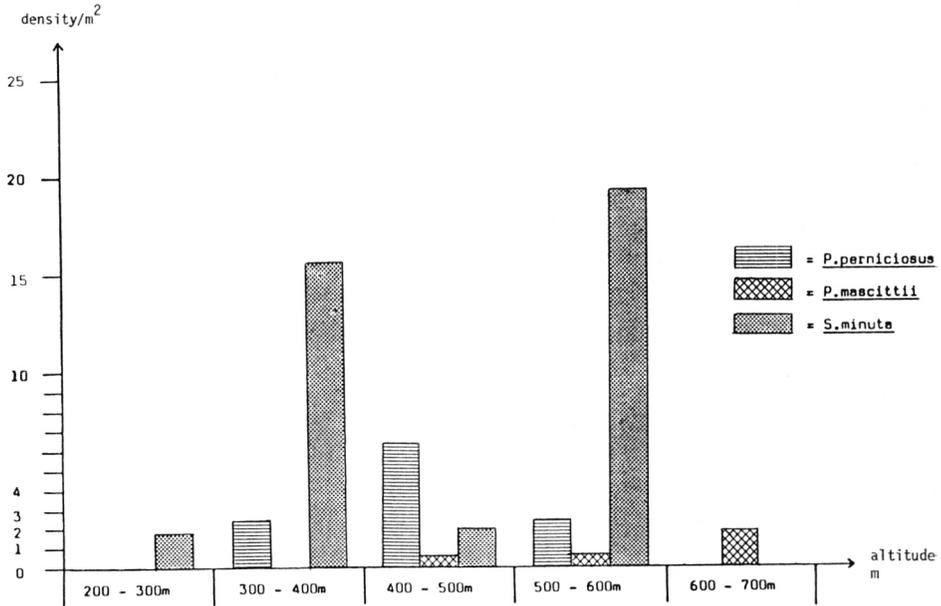


FIG. 6. — Vertical distribution of sandflies in southern Ticino.

CAPTURE-DATA WITH LIGHT TRAPS IN DIFFERENT BIOTOPES

In suitable biotopes, the number of *P. perniciosus* and *P. mascittii* caught was increased by using light traps indicating that sampling methods significantly influences catch numbers.

In addition, in the present study, larger numbers (at one site, 38) of *S. minuta* were caught using sticky papers placed inside drain holes, than with light traps placed close to the biological niche. Conversely, Rioux *et al.* (1969) caught many more specimens when light traps were used in conjunction with sticky papers, within the biological niche itself. This supports the conclusion that *S. minuta* is more dependent upon a well-defined microclimate which it is unwilling to leave.

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