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Study on the flying height of *Leptoconops noei* and *Leptoconops irritans* in southern Italy

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Abstract

The vertical distribution of *Leptoconops noei* Clastrier et Coluzzi and *Leptoconops irritans* (Noè) was studied in the natural area of Basento mouth by sticky traps. The traps were placed at 2, 4 and 6 meters from the ground level in open and vegetated areas. 94.4% of *Leptoconops* specimens was collected below 4 m height, while the maximum theoretical flight height was estimated in 6.55 m. No significant differences were observed concerning the vertical distribution of the two species. The vegetation seems to influence distribution and height of *Leptoconops* flight.

Key words: *Leptoconops noei*, *Leptoconops irritans*, flying height, barriers, sticky traps.

Introduction

Biting midges includes three important genera of haematophagous flies: *Culicoides*, *Leptoconops* and *Forcipomyia* (subgenus *Lasiohelea*) (Kettle, 1962). Although biting midges belonging to the genus *Leptoconops* are not known to spread diseases to humans or livestock, where occurring in large numbers they often become a major cause of nuisance due to their aggressive diurnal biting activity. In Italy the presence of *Leptoconops* was noticed in several coastal areas in Emilia-Romagna (Coluzzi, 1967), Tuscany (Coluzzi and Finizio, 1966; Bettini *et al.*, 1969), Latium (Noé, 1907; Clastrier and Coluzzi, 1973), Apulia (De Marzo and Moleas, 1979) and Sicily (Lavagnino *et al.*, 1990).

Along the Ionic coast of Matera Province (Basilicata Region, Italy) haematophagous activity due to *Leptoconops irritans* (Noè) and *Leptoconops noei* Clastrier et Coluzzi can seriously impact tourism activities in wide areas from May to July (Carrieri *et al.*, 2005).

Therefore, starting from 2000 a control program against haematophagous insects including biting midges has been carried out with the aim of reducing nuisance by privileging low environmental impact measures.

Information concerning life cycle and breeding sites of *Leptoconops* in Italy are actually rather poor. Bettini and Finizio (1968), Bettini *et al.* (1969) and Majori *et al.* (1971) have carried out some studies involving breeding sites identification and geological characterisation along the coastal area near Grosseto (Tuscany). Analysis on soil samples taken from larval breeding sites located close to the Ombrone river mouth revealed that *L. irritans* larvae grow in soil characterised by high rates of clay (data not published).

At the moment the reduction/elimination of larval breeding sites is largely impractical due to their location in proximity of Basento river banks and mouth. At the same time adulticide treatments showed low efficacy in reducing *Leptoconops* densities below the tolerable levels requested for tourism activities. From field observations Carrieri *et al.* (2005) noted that *Leptoconops* adults passively transported by the wind tend to accumulate in some specific locations, especially natural belts (dunes, trees or bushes) and artificial ones (urban areas or tourist resorts). Therefore an experimental control project was started, with the aim to test some artificial barriers useful in reducing the spread of adults *Leptoconops* into tourist resorts and concentrating them in more restricted zones where adulticide treatments efficacy would be improved.

We plan this work with the main purpose to analyse the flying height of *Leptoconops*, and collecting parameters useful to plan an artificial barrier system.

Materials and methods

The study was carried out in the Ionic coast of Matera Province, near the Basento river mouth (figure 1). Metapontino coastal area show a first belt of vegetation mainly constituted by *Ammophila arenaria* (L.) Link,

Figure 1. Study area: Basento river mouth with position of sampling stations.

Figure 2. Sampling stations location.

Eryngium maritimum L., *Echinophora spinosa* L., *Pancratium maritimum* L., *Carpobrotus acinaciformis* (L.) L. Bolus. Behind the dunes bushes of *Juniperus macrocarpa* Sibthorp et Smith, *Tamarix gallica* L., *Pistacia lentiscus* L., *Atriplex halimus* L. prevail, followed by *Acacia cyanophylla* Lindley, *Acacia retinodes* Schlechtental, *Juncus* spp. Inland species as *Olea europaea* L., *Quercus ilex* L., *Pinus halepensis* Miller, *Acacia saligna* (Labillardière) H.L. Wendland, *Eucalyptus globulus* Labillardière, *Eucalyptus rostrata* von Schlechtendal, *Pinus pinea* L. and *T. gallica* are well established.

Flying height of adult *Leptoconops* was estimated at 3 monitoring stations where PVC poles 6 m high were installed. Adult *Leptoconops* catches were realised using sticky traps (20 x 30 cm white paper sheets impregnated with castor oil) hung on the pole at heights of 2, 4 and 6 m. In choosing the sampling technique, dry ice baited traps were discarded in order to avoid the CO_2 stratification influence on collection efficiency, as well as light traps considering the diurnal activity of *L. noei* and *L. irritans*.

The monitoring stations were installed side by side to the coastline, 500-780 m far from the sea. Station 1 was the closest to Basento (50 m far from the river and from *Leptoconops* breeding site) and was located near to a tamarisk (*T. gallica*) hedge 3-4 m high. Station 2 and 3 (300 and 860 m from the river respectively) were placed in an open area (figure 2). The investigation was performed from June 14th to June 20th 2005 and sticky traps replaced every 2 days, during the no-flight period in order to avoid accidental catches during sheet substitution. Data, after the angular transformation of percentage, were analysed with one-way and two-ways ANOVA followed by Newman-Keuls test. Data collected from stations 2 and 3, located in open area, were analysed together.

Results and discussion

Totally 1,743 adults *Leptoconops* were collected during the 6 days monitoring period, of which 80.1% were *L. noei* and 19.9% *L. irritans* (figure 3).

No significant differences were observed in the ratio between the two species in relation to height collection ($F = 0.72$ and $P = 0.54$), but at 2 and 4 m *L. noei* percentage resulted higher (79.90% ± 20.27 SD and 84.74% ± 5.59 SD respectively) than at 6 m high (50.00% ± 50.00 SD).

The number of *Leptoconops* caught resulted higher in the vegetated station than in the open station (figure 4).

The comparison (two-way ANOVA) between the vertical distribution obtained in the vegetated area (station 1) and in the open area (station 2 and 3) shows an higher percentage of *Leptoconops* at 2 m height in the vegetated station while at 4 m the catches resulted higher in open area. At 6 m no significant differences between

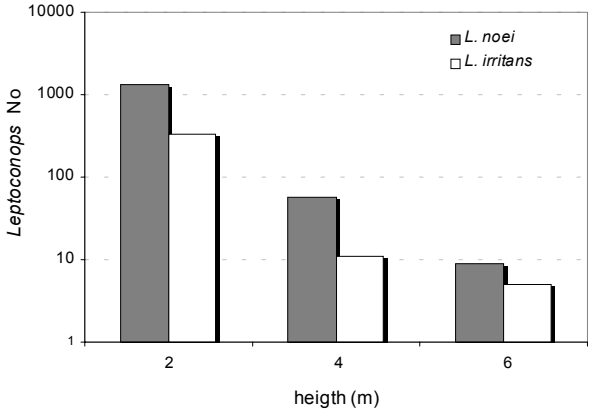

Figure 3. Adult collections of *L. noei* and *L. irritans* obtained at various sampling heights.

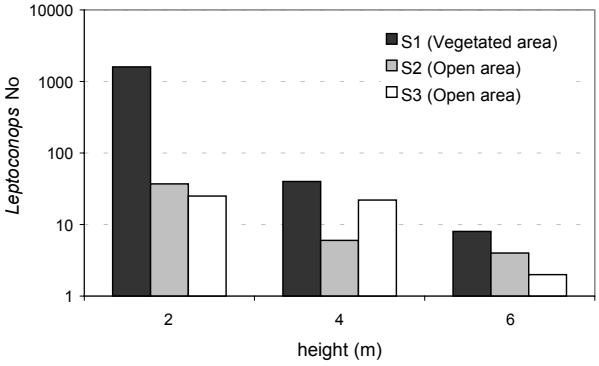

Figure 4. Total collections of adult *Leptoconops* obtained in the 3 sampling stations.

Table 1. Two ways ANOVA of vertical distribution related to the location.

	SS	DF	MS	F	P
Intercept	8.2590	1	8.2590	215.5440	0.0000
Height	3.9225	2	1.9612	51.1850	0.0000
Location	0.0070	1	0.0070	0.1828	0.6733
Height*location	0.8216	2	0.4108	10.7215	0.0006
Error	0.8046	21	0.0383		

Table 2. Relative percentage of catches obtained at different heights at station in vegetated area and at stations in open area (Newman-Keul test, $P < 0.05$).

Height (m)	Vegetated area				Open area			
	N	Mean %	SD		N	Mean %	SD	
2	4	91.93	5.96	a	5	56.38	22.15	a
4	4	5.99	3.87	b	5	35.10	23.29	a
6	4	2.07	3.76	b	5	8.52	9.74	b

locations were observed (table 1 and figure 5). At station 1 almost 91.9% of *Leptoconops* were caught at 2 m of height, 6.0% at 4 m and 2.1% at 6 m (table 2).

Collections at 2 m are significantly higher when compared with catches at 4 and 6 m ($F = 115.52$ and $P < 0.00001$).

At the two stations located in open area 56.4% of catches were obtained at 2 m, 35.1% at 4 m and 8.5% at 6 m. No significant differences resulted between catches obtained at 2 and 4 m, even if over the half of total *Leptoconops* were caught at the lower height. While significant differences ($F = 8.39$ and $P < 0.01$) were observed between 2 and 4 m in comparison with 6 m.

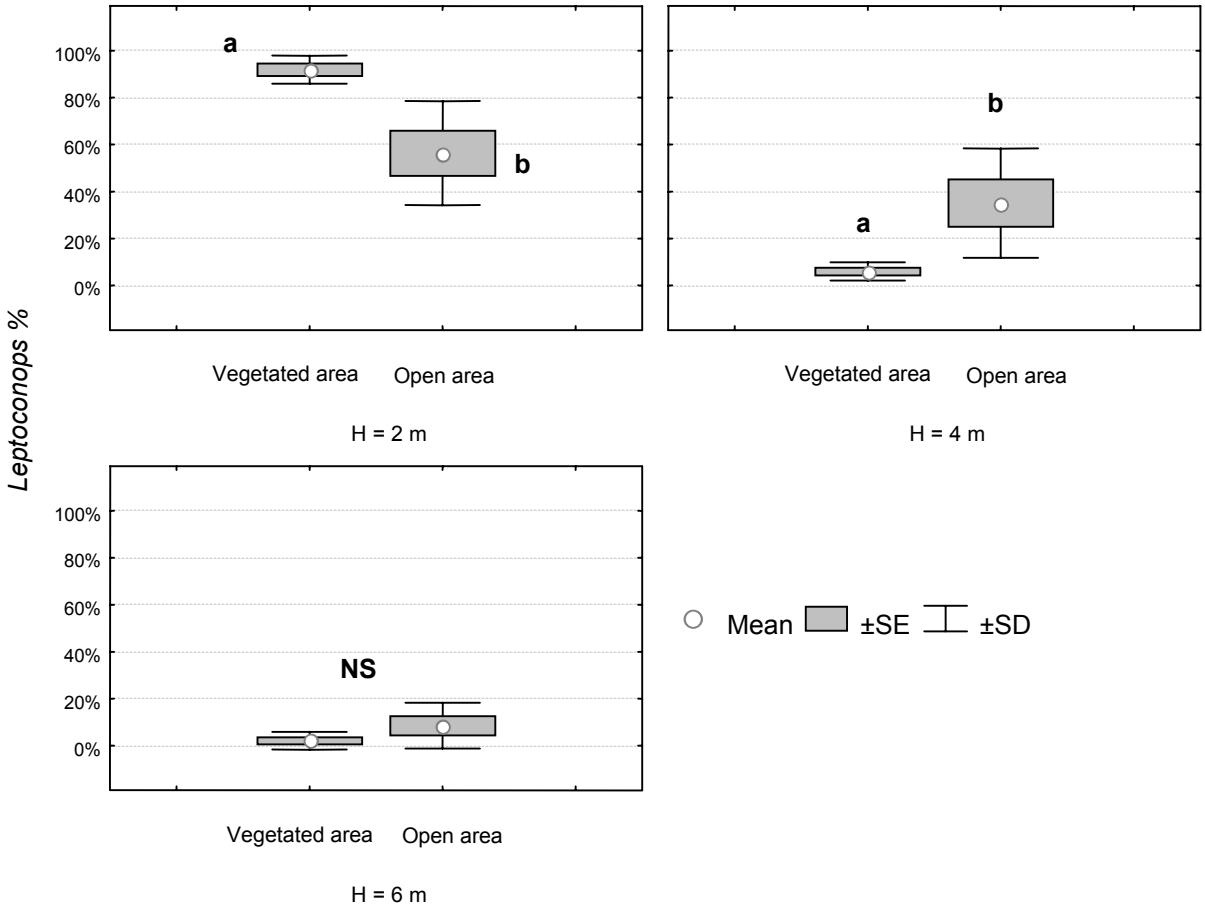

Figure 5. Comparison of vertical distribution observed in vegetated and open area.

When considering the data cumulatively, significant differences are observed among the three tested height levels (F = 26.7 and P < 0.0001): 72.2% of the total amount of specimens is collected at 2 m of height, 22.2% at 4 m, while only 5.6% is caught at 6 m of height.

Significant differences are also observed in the average eight of flight in relation to catch station (F = 9.92 and P < 0.016). The average eight of flight resulted 2.20 m (± 0.18 SD) in vegetated area and 3.04 m (± 0.50 SD) in open area.

When analysing the average eight of flight of singular species we noticed significant differences in relation to catch station (2 way ANOVA F = 6,06 and P < 0,03). In open area height of flight resulted different for the two species, while in vegetated area the value resulted similar (figure 6).

Catches and height are linearly related by the following equation:

(1) $C = 1.4344 – 0.2190 * H$

where C is the arcsin square root transformed percentage of collections and H is the height (m) ($R^2 = 0.66$, F (1.25) = 47.607 and P < 0.00 SE of estimate 0.27) (figure 7 and table 3).

By using the equation (1) the estimation of the maximum theoretical flight height results $H_{max} = 6.55$ m.

Leptoconops species affecting the area surrounding the Basento river mouth have a very similar vertical distribution. The most part (94.4%) flies up to 4 m of height. Natural vegetation (and perhaps artificial windbreak barrier) may influence the vertical and spatial distribution of these small dipterans. Actually collections and field observations show that in the urban area of Metaponto Beach, which is protected by a reforestation belt of *Eucalyptus* and *Pinus*, the presence of *Leptoconops* is much lower than in the epicentre. We therefore suggest the hypothesis to test windbreak barrier, exploiting a concept already present in the area to protect citrus plantations, to defend the tourist resorts in the area. Barriers' orientation has to be defined in relation to breeding sites location, predominant winds and adequate distance to tourist resorts, while their height should be not less than 5-6 m.

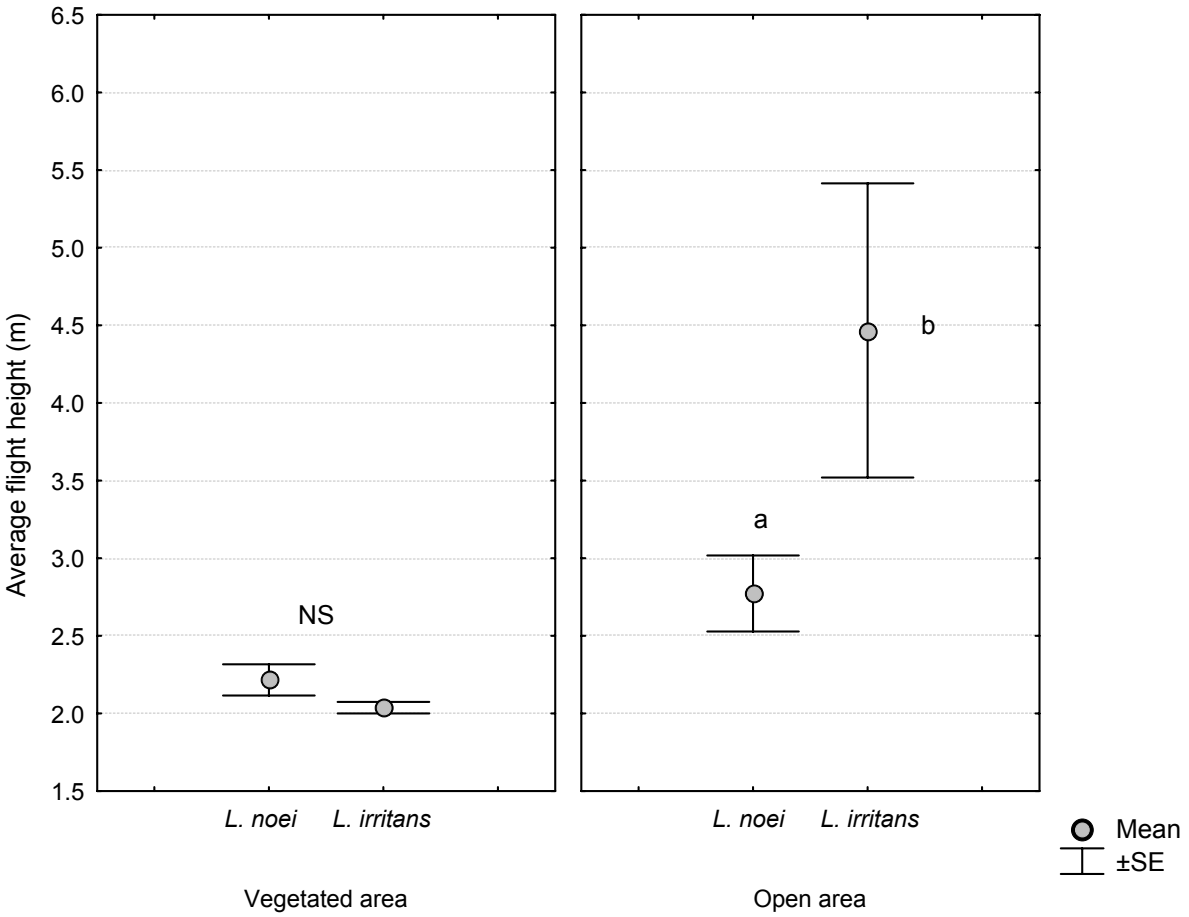

Figure 6. Average flight height in meters ofi *L. noei* and *L. irritans* in vegetated and in open area.

Table 3. Regression parameters of linear regression between catches (arcsin √ %) and height.

	Beta	SE of Beta	B	SE of B	t (25)	P
Intercept			1.4344	0.1371	10.4587	0.0000
Height (m)	-0.8097	0.1173	-0.2190	0.0317	-6.8997	0.0000

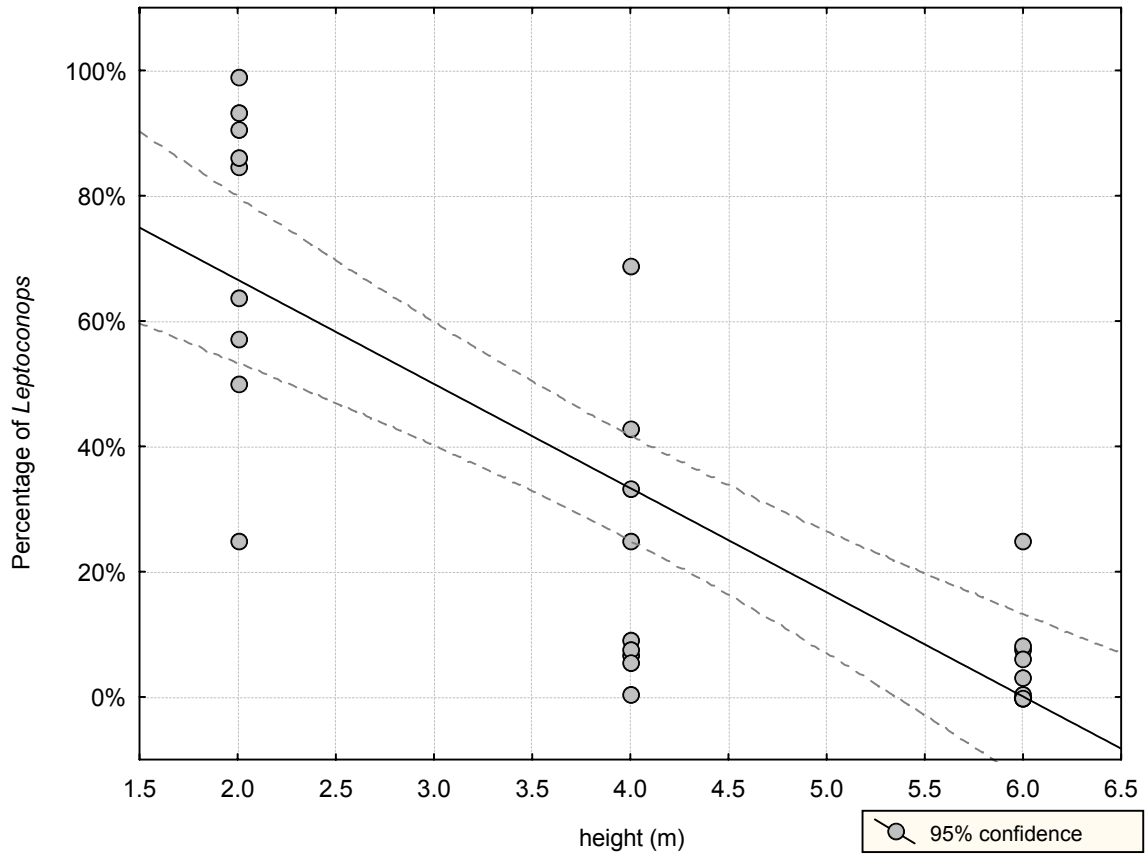

Figure 7. Linear regression between percentage of *Leptoconops* catches and trap height.

Acknowledgements

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