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Weather stations and the data reports from Romania as part of the East-BTNet project

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Summary

The authors present data collected by six weather stations placed in Romania, as part of the East-BTNet regional project. The weather stations were equipped with smart sensors to collect information on air and soil temperature, atmospheric relative humidity, soil moisture and wind speed, factors that may influence the development and activity of *Culicoides* insects, vectors of bluetongue virus. Concomitantly with the monitoring of the environmental parameters, insects were captured, examined and identified according to the standard methods. The six weather stations were placed in locations with different geo-climatic conditions (seaside, mountains, plateaux and plains) to establish whether there is a correlation between environmental parameters and insect populations, especially for the Pulicaris, Obsoletus and Nubeculosus Complexes. A correlation between environmental conditions and the activity of vector populations was observed. The characteristics of the climate influenced the size of vector populations (sub-Mediterranean climate in the south-west and temperate continental climate in the centre of the country).

Keywords

Bluetongue, *Culicoides*, Environment, Geographic information system, Monitoring, Parameter, Romania, Vector, Weather station.

Le stazioni meteorologiche e il sistema di reportistica dei dati dalla Romania nell'ambito del progetto East-BTNet

Riassunto

Gli autori presentano i dati raccolti da sei stazioni meteorologiche posizionate in Romania, come parte del progetto East-BTNet. Le stazioni meteorologiche sono state equipaggiate con sensori smart in grado di raccogliere informazioni sulla temperatura dell'aria e del suolo, sull'umidità relativa atmosferica, sull'umidità del suolo e sulla velocità del vento, fattori che possono influenzare lo sviluppo e l'attività dei Culicoides, *insetti vettori del virus della* bluetongue. *Contemporaneamente al monitoraggio dei parametri ambientali, gli insetti sono stati catturati, esaminati ed identificati secondo i metodi standard. Le sei stazioni meteorologiche sono state posizionate in differenti siti con differenti condizioni geo-climatiche (costa marina, montagne, altopiani e pianure) al fine di stabilire se ci sia una correlazione tra i parametri ambientali e la popolazione di insetti, in particolar modo per i complessi di specie Pulicaris, Obsoletus e Nubeculosus. E' stata osservata una correlazione tra le condizioni ambientali e l'attività delle popolazioni di vettori. Particolari caratteristiche del clima hanno influenzato la consistenza della popolazione dei vettori (il clima sub-meditterraneo nel sud-ovest e il clima continentale nel centro del paese).*

Parole chiave

Ambiente, Bluetongue, *Culicoides*, Monitoraggio, Parametri, Sistema informativo geografico.

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Introduction

This study presents the analysis of some of the data recorded by six HOBO® weather stations placed in the field during the international project 'Cooperation for implementing a surveillance network for bluetongue (BT) in the Balkan area – East-BTNet', coordinated by the *Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise 'G. Caporale'* in Teramo, Italy, in collaboration with the Joint Research Centre, Institute for the Protection and Security of the Citizen in Ispra (Italy). The Romanian Institute for Diagnosis and Animal Health participated as a pilot partner during the project, especially due to the fact that BT had previously been diagnosed in countries neighbouring Romania (Bulgaria 1999, 2001 and Serbia 2003).

The surveillance of BT in Romania is undertaken by including relevant epidemiological information, including the biology and ecology of vectors (insects of the genus *Culicoides*), and environmental factors that influence the distribution and abundance of *Culicoides*. In particular, the occurrence of BT in other Balkan and neighbouring countries in previous years (Bulgaria 1999, 2001 and Serbia 2003) encouraged the Romanian veterinary authorities to establish a national surveillance network that included the monitoring of both infection and vectors.

The selection of locations of the six HOBO® weather stations was made taking into account the following criteria:

- presence of animals that are susceptible or attracted to *Culicoides* (ruminants, ovine, swine, fowl)
- risk of BT virus introduction into Romania from infected neighbouring countries (e.g. Caras Severin county)
- characteristics of the environment in general (soil type, vegetation, longitude and latitude) and specifically in relation to altitude: flat areas (Constanta, Arad counties), hilly or mountainous areas (Cluj, Botosani, Brasov).

Materials and methods

Six HOBO® weather stations were equipped with four smart sensors and a data logger that recorded the following climatic data:

- wind speed (m/s)
- relative humidity of air (%)
- air temperature (°C)
- soil humidity (m^3/m^3 of water content)
- soil temperature (°C).

The HOBO® weather stations were also equipped with a South African type blacklight traps used to capture the vectors.

The latitude, longitude and altitude of the site were recorded using commercial global positioning system (GPS) devices. Climatic data were downloaded regularly using specific software (Box Car Pro 4 developed by the Joint Research Centre), which enables the recording of data in Microsoft® Excel format for further analysis.

Two insect collections were studied for each location where climatic variables were monitored (a initial collection during the warm season and a second during the cold season) to observe the influence of climatic variables on the activity and abundance of insect populations. Samples of *Culicoides* were sorted, counted and identified using the methods recommended by the *Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise 'G. Caporale'* BT reference laboratory (1).

Results and discussion

In 2005, six HOBO® weather stations were installed in Romania to study climate variables that influence *Culicoides* distribution and abundance (Fig. 1).

In the period under study (2005-2006) three HOBO® weather stations placed in south-east (Constanta), west (Arad) and centre (Brasov) did not operate correctly due to the absence of a suitable adapter to download the data collected.

The results presented in this study, therefore, concern the data collected from weather stations in the south-west (Caras-Severin) and centre (Cluj).

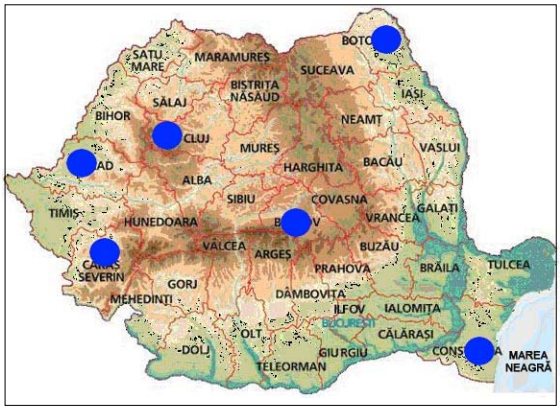

Figure 1
Location of the HOBO weather stations in Romania

An analysis of data obtained from the weather station located in north-east (Botoşani) will be discussed in another paper.

The HOBO® weather station referenced 3/CS/2005 was placed in the south-west of the country, in the Caraş-Severin (Gradinari) area (Fig. 2). The geographic coordinates of the location were: latitude 45.110886 longitude 21.900230 at an altitude of 94.88 m. Large numbers of animals of susceptible species (cattle, goats and wild ruminants) were present.

Figure 2
Location of HOBO weather station code 3/CS/2005

The data collected by the 3/CS/2005 HOBO® weather station show high variations in the climatic parameters during the period under study (Fig. 3).

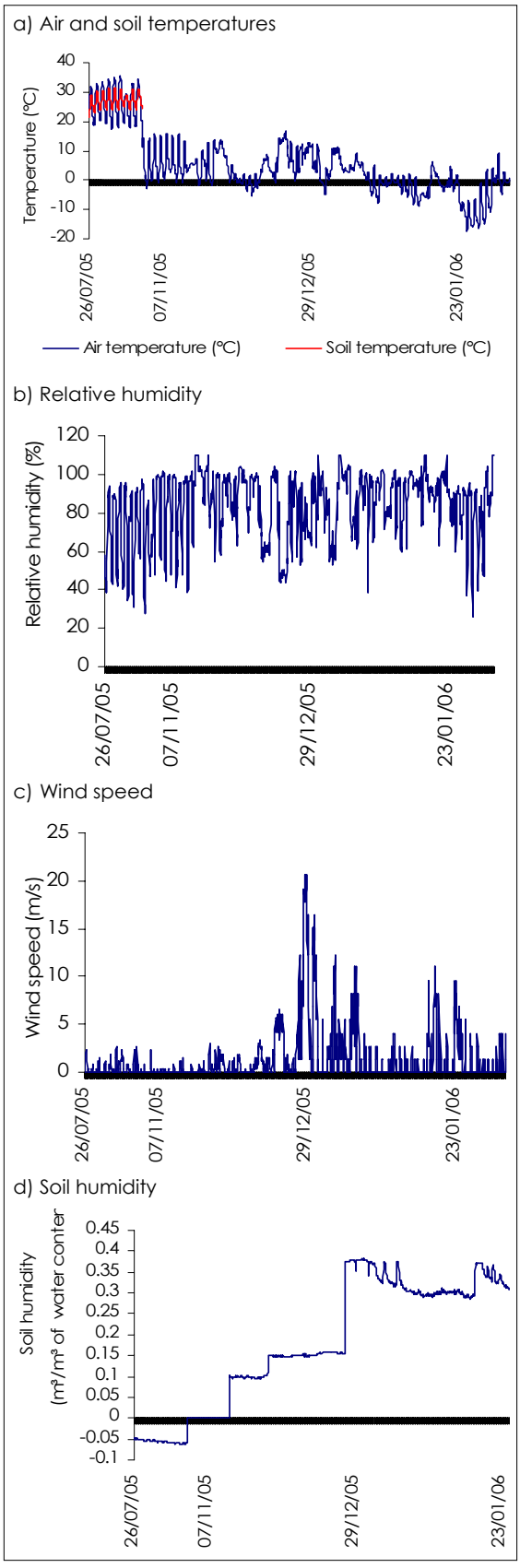

Figure 3
Environmental parameters in Gradinari, 26 July-4 August 2005 and 3 November 2005-31 January 2006

Table I and Figure 4 show the values of the climatic parameters recorded at hourly intervals during the night when the collection of vectors was performed (Collection no. 1).

During the night of 26 to 27 July 2005 in Gradinari (Collection no. 1), the air and soil temperatures exceeded 20°C. The relative humidity of air increased at the beginning of the evening and then remained constant at around 90%. The wind speed was below 1m/s and the soil humidity under 1 m^3/m^3.

Table II and Figure 5 present the data on vector populations collected during the night. The most representative complex was

Table I
Climatic values during vector collection, registered at hourly intervals in Gradinari (Collection no. 1)

Date and time	Air temperature (°C)	Relative humidity of the air (%)	Wind speed (m/s)	Soil temperature (°C)	Soil water content (m^3/m^3)
26 July 2005 19:33	30.31	54.25	0.38	28.31	–0.04757
26 July 2005 20:33	27.52	73.25	0	27.91	–0.048
26 July 2005 21:33	23.63	86.25	0	27.12	–0.04885
26 July 2005 22:33	22.86	88.25	0.38	26.34	–0.04927
26 July 2005 23:33	22.09	89.25	0.38	25.56	–0.04969
27 July 2005 00:33	21.33	88.25	0	25.17	–0.05012
27 July 2005 01:33	20.57	90.75	0	24.79	–0.05097
27 July 2005 02:33	20.19	90.75	0	24.01	–0.05139
27 July 2005 03:33	19.04	93.75	0	23.63	–0.05139
27 July 2005 04:33	19.81	90.25	0	23.24	–0.05139
27 July 2005 05:33	18.66	92.25	0	23.24	–0.05224
27 July 2005 06:33	18.66	91.75	0	22.86	–0.05224
27 July 2005 07:33	20.19	88.75	0	22.86	–0.05224

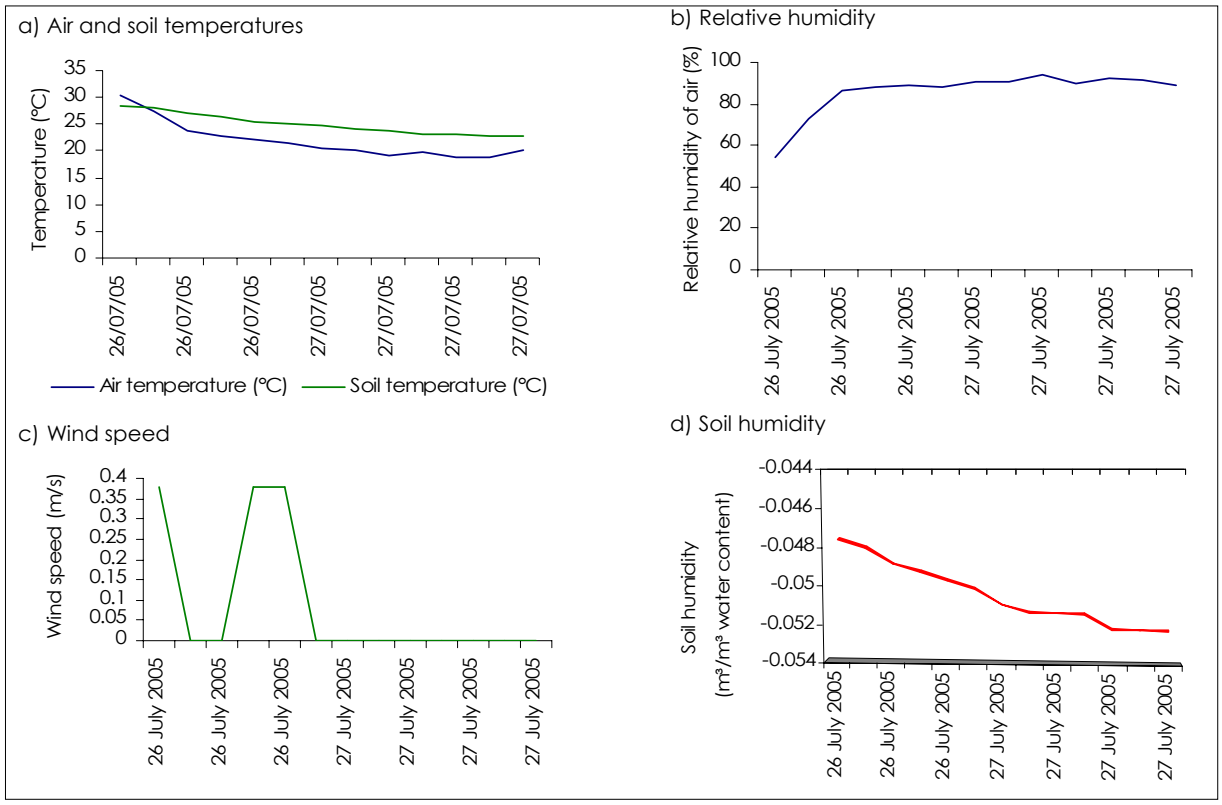

Figure 4
Environmental parameters during the collection of vectors (Collection no. 1) in Gradinari, night of 26 to 27 July 2005

Table II
Characteristics of vector population in Gradinari (Collection no. 1)

Characteristics	Values
Total no. of insects	4 695
Total no. of *Culicoides*	822
Culicoides among total insects (%)	17.5%
No. of midges of Obsoletus Complex	693
Obsoletus Complex out of total *Culicoides* (%)	84.3%
No. of midges: Pulicaris Complex	3
Pulicaris Complex out of total *Culicoides*	0.36%
No. of midges: other species	117
Other species out of total *Culicoides* (%)	14.25%

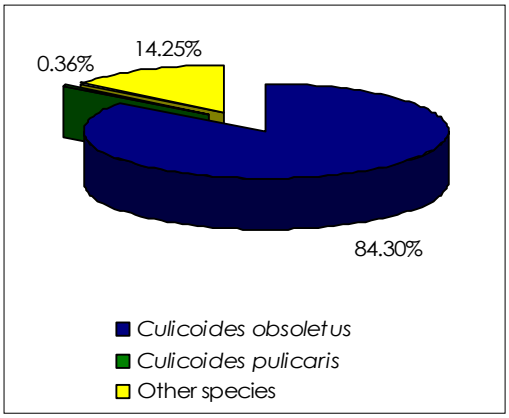

Figure 5
Distribution of the percentage of *Culicoides* species in Gradinari (Collection no. 1)

Culicoides obsoletus which accounted for 84.3% of the total number of *Culicoides* collected.

A second insect collection was performed on the night of 21 to 22 November 2005 in Gradinari (Fig. 6) when a single insect was collected. The climatic variables were unsuitable for insect activity with air temperatures below 0°C, high relative humidity of the air, soil humidity below 1 m^3/m^3 , and wind speed values of below 1 m/s.

The weather station reference 2/CJ/2005 was located in the Cluj district (Fig. 7), at Hoia at an altitude of 127 m, latitude 46.910277 and longitude 23.720277. The weather station was placed close to a forest. The location also had a large number of receptive animals (horses, sheep, cattle, fowl, pigs).

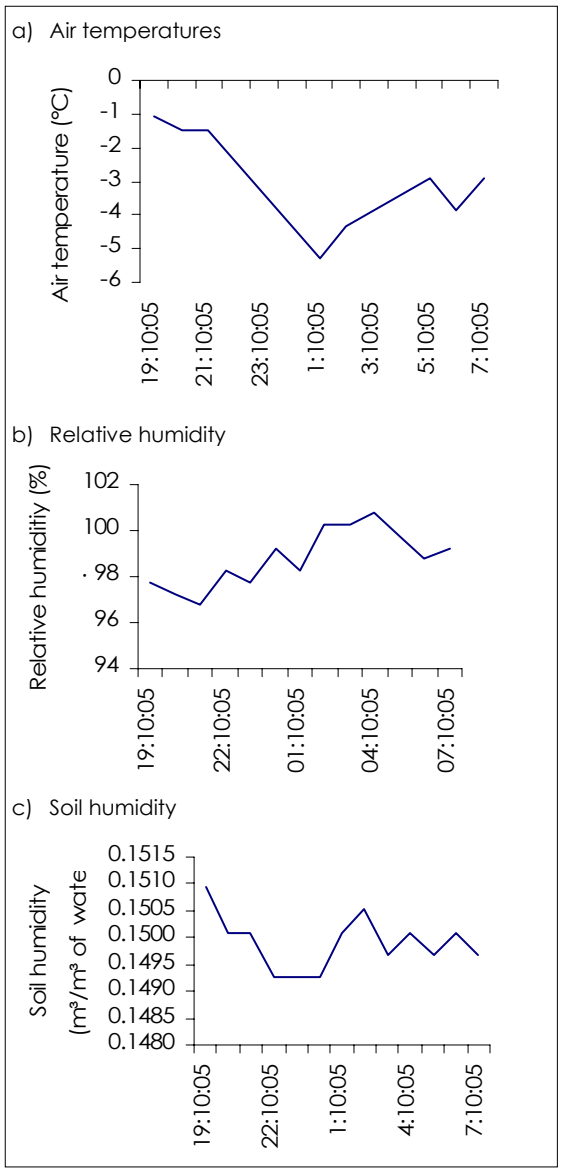

Figure 6
Environmental parameters during vector captures in Gradinari, night of 21 to 22 November 2005 (Collection no. 2)

Figure 7
Location of HOBO weather station code 2/CJ/2005

The data collected by HOBO® weather station 2/CJ/2005 during the period under study is presented in Figure 8.

In Hoia during the night of 2 to 3 October 2005 (Collection no. 1) the air and soil temperatures were 9-18°C, the relative air humidity reached 100%, wind speed was below 1m/s and water content of the soil was below 1 m^3/m^3 (Table III and Fig. 9).

The total number of insects collected that night amounted to 2 955, of which 2 750 were *Culicoides*, representing 93.06% of the total number of insects collected (Table IV and Fig. 10).

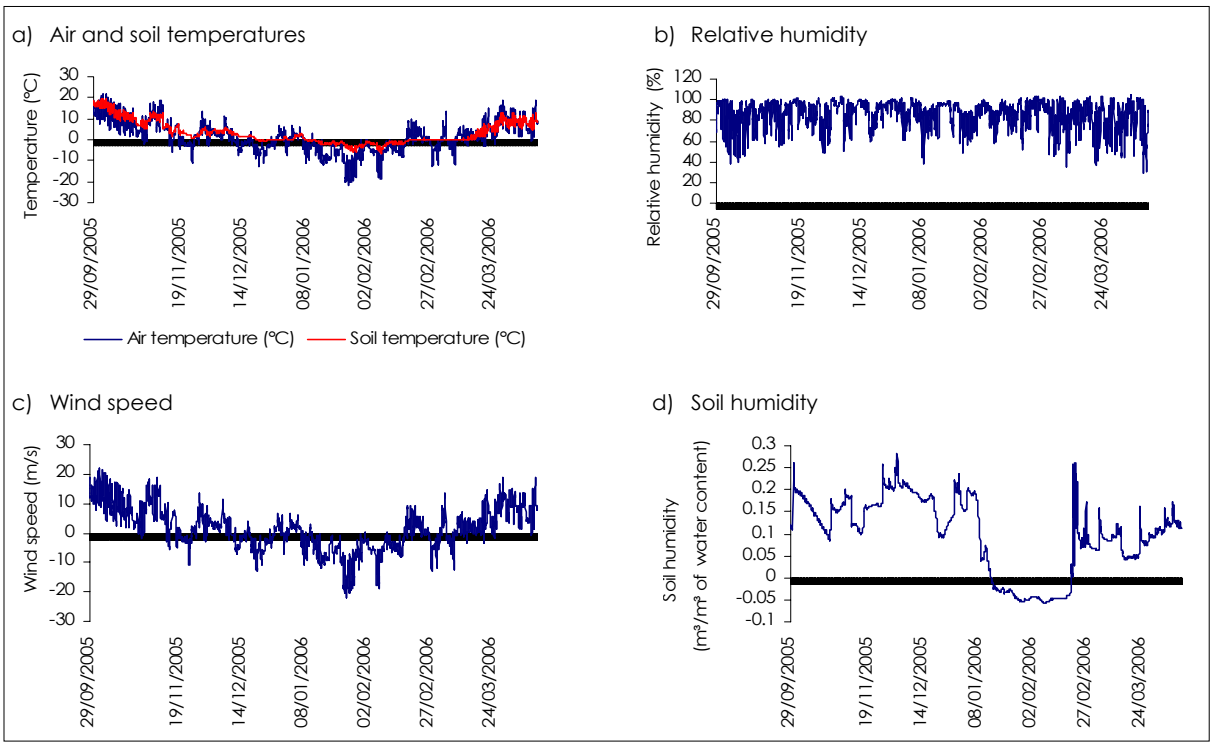

Figure 8
Environmental parameters in Hoia between 29 September 2005 and 11 April 2006

Table III
Climatic values during the vector collection, registered at hourly intervals in Hoia (Collection no. 1)

Date/time	Air temperature (°C)	Relative humidity of the air (%)	Wind speed (m/s)	Soil temperature (°C)	Soil water content (m^3/m^3)
10/02/05 19:50:04.0	14.47	92.25	0	17.90	0.19676
10/02/05 20:50:04.0	13.7	95.25	0	17.52	0.19591
10/02/05 21:50:04.0	12.55	97.75	0	17.14	0.19464
10/02/05 22:50:04.0	11.38	98.25	0	16.76	0.19464
10/02/05 23:50:04.0	11.38	99.25	0	16.38	0.19295
10/03/05 00:50:04.0	10.21	99.75	0	16.00	0.1921
10/03/05 01:50:04.0	10.21	100.25	0	15.62	0.19167
10/03/05 02:50:04.0	9.42	100.25	0	15.23	0.1904
10/03/05 03:50:04.0	9.42	99.25	0	15.23	0.19082
10/03/05 04:50:04.0	10.21	99.75	0	15.23	0.19082
10/03/05 05:50:04.0	10.6	100.25	0	15.23	0.18998
10/03/05 06:50:04.0	11.38	100.25	0	15.23	0.18998
10/03/05 07:50:04.0	11.77	100.25	0	15.62	0.18998

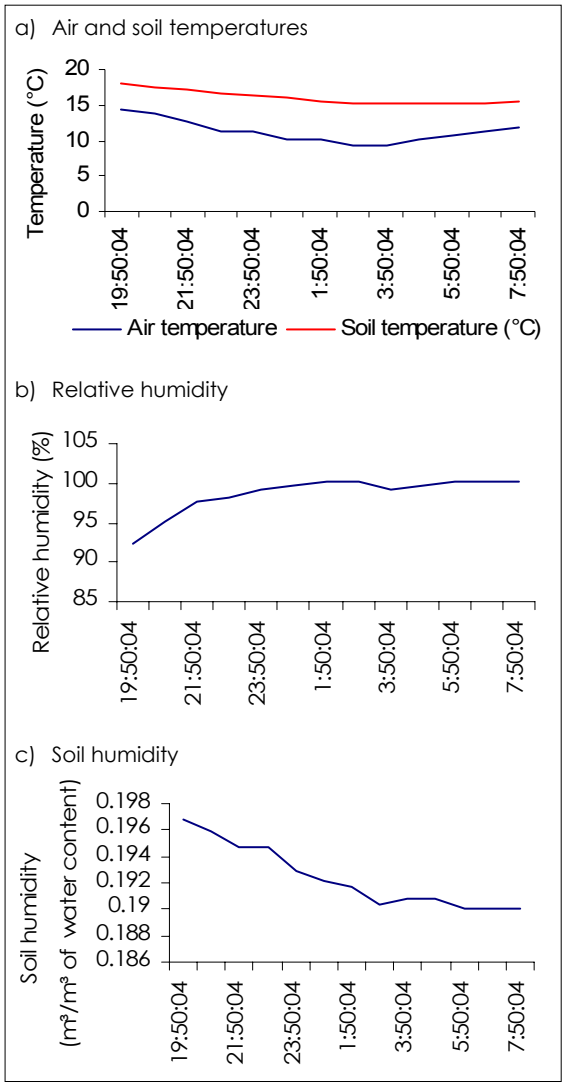

Figure 9
Representation of environmental parameters during the collection of vectors in Hoia, night of 2 to 3 October 2005 (Collection no. 1)

Table IV
Characteristics of vector population in Hoia (Collection no. 1)

Characteristics	Values
Total no. of insects	2 955
Total no. of *Culicoides*	2 750
Culicoides among total insects (%)	93.06%
No. of midges: Obsoletus Complex	600
Obsoletus Complex out of total *Culicoides* (%)	21.82%
No. of midges: Pulicaris Complex	330
Pulicaris Complex out of total *Culicoides* (%)	12 %
No. of midges: other species	1820
Other species out of total *Culicoides* (%)	66.18 %

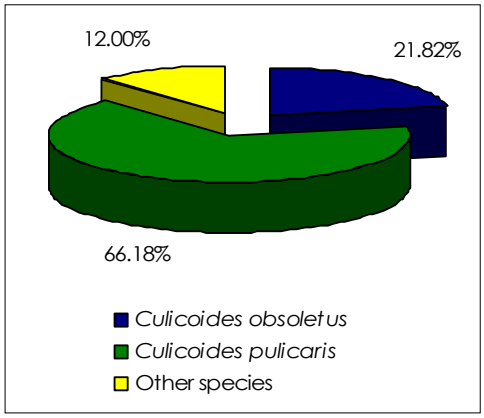

Figure 10
Distribution of the percentage of *Culicoides* species in Hoia (Collection no. 1)

No insects were collected during the second collection in Hoia on the night of 21 to 22 February 2006 with air temperature below 10°C, soil temperature below 0°C, wind speed below 1m/s, relative air humidity approximately 89-99% and water content of the soil below 1 m^3/m^3 (Fig. 11).

Conclusions

The values of climatic variables were recorded during both warm and cold seasons and led to a correlation between climatic factors and the vector population in the area under study.

The value of the environmental parameters (especially the air temperature) during the cold season (for example November and January) in Gradinari showed a significant variation during the warm season. These environmental parameters were unsuitable for both activity and size of the insect population, a fact reflected by the second capture during the night of 21 to 22 November 2005.

Also observed in Gradinari, was the fact that when environmental parameters were situated at optimal values (for example in July), *Culicoides* activity was very intense. During the night of collection, 4 695 midges were captured and insects from the Obsoletus Complex were predominant (84.3%).

Similarly, in Hoia, when climatic factors were suitable for the survival and activity of vectors (temperatures values exceeding 10°C and wind

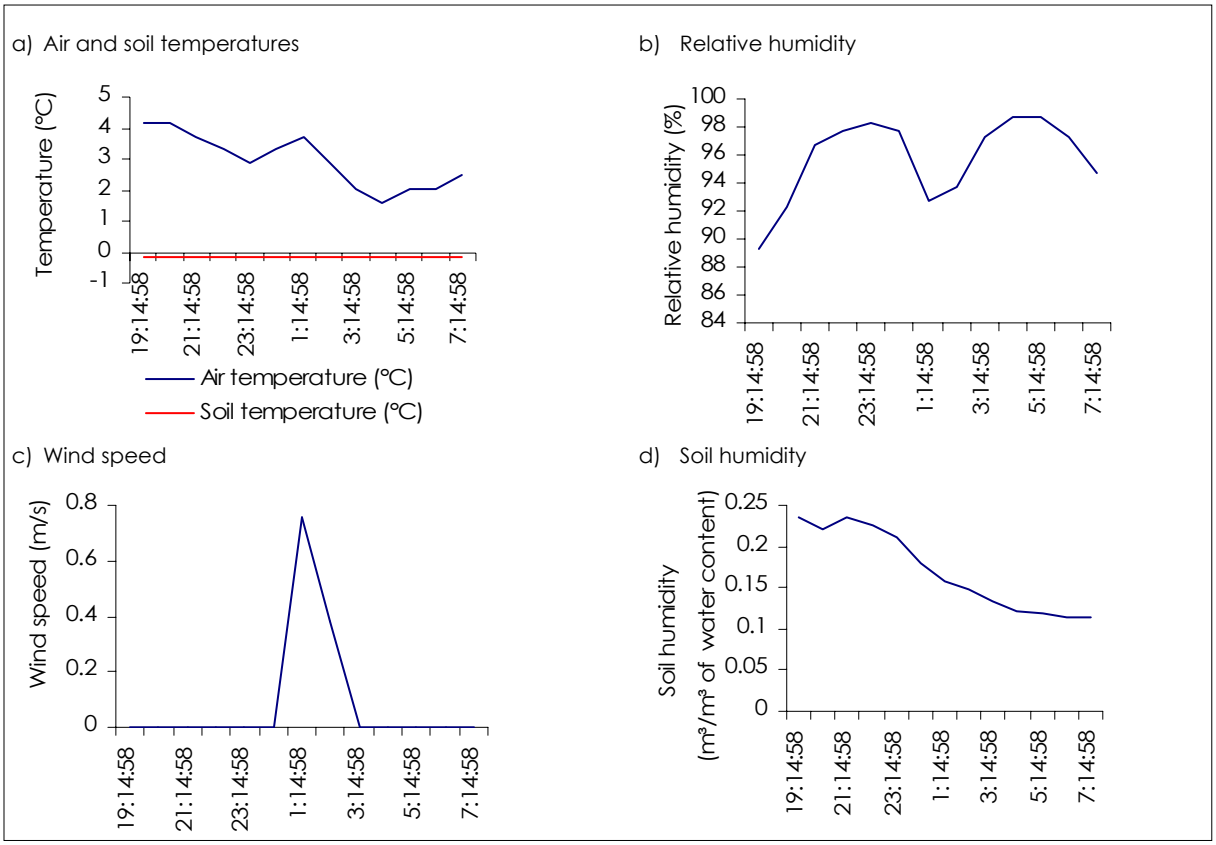

Figure 11
Environmental parameters during the collection of vectors in Hoia, night of 21 to 22 February 2006 (Catch no. 2)

speed values of below 1m/s), a large number of insects and *Culicoides* vectors were active during the cold season, when the temperature, wind speed and soil water content values were very low but relative air humidity increased, no insects and consequently no vectors were active.

The different environmental conditions when insect captures were made in both Gradinari and Hoia demonstrated that environmental factors (air and soil temperatures, relative air and soil humidity and wind speed) have a significant influence on the activity and size of *Culicoides* vector populations.

The location of the two areas studied at different geographic coordinates (45°N and 47°N) had no influence on the size of *Culicoides* vector populations.

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