Lagascalia 19(1-2): 719-724 (1997)

RELATION BETWEEN SOME ENVIRONMENTAL PARAMETERS AND SANTOLINA ETRUSCA (LACAITA) MARCHI ET DIAMATO OCCURRENCE IN THE STREAM BEDS OF CENTRAL ITALY

CLAUDIA ANGIOLINI & ALDEMARO BOSCAGLI

Abstract

The relation between the occurrence of *Santolina etrusca*, a species endemic of Central Italy, in the stream beds and some environmental parameters (stream bed vegetation, stream bed characteristics, watercourse regime, altitude, exposure, prevailing geology in the neighbourhoad of the station) have been studied by multivariate analysis. The results show that the presence of *S. etrusca* along streams is closely related to wide stream beds with garigue and a very permeable stoney-sandy substrate.

Introduction

Santolina etrusca (Lacaita) Marchi et D'Amato is a species endemic to Central Italy (Tuscany, Latium and Umbria). Its centre of distribution is in the Mt. Amiata area (ANGIOLINI & al., 1996) and its locus classicus (LACAITA, 1925) along the Orcia river below Radicofani. It grows on Mt. Amiata at low altitudes (until 800 m) and can also be found along roads, on shrubby untilled land and in sunny degraded oak-woods. It spreads towards the Maremma, Umbria and Northern Latium (ARRIGONI, 1979) along the Albegna, Fiora, Paglia, Orcia and Ombrone rivers.

The aim of this study, which is part of a research project on the distribution, phytosociology, and synecology of *S. etrusca*, was to go further on the ecological knowledge of this species by relating its presence along river beds with a series of environmental parameters.

Study area

The study area (Fig. 1), which roughly corresponds to the main area of distribution of *S. etrusca*, includes Mt. Amiata, the neighbouring Maremma, and parts of Northern Latium and Umbria. The total area is ca. 1800 sq.Km and altitude ranges from 20 to 800 m.

Climate is mesothermic according to THORNTHWAITE's (1948) classification, ranging from subarid or arid from May to September with moderate winter rainfall (Grosseto and Spedaletto (SI)), to humid with moderate summer drought (Pitigliano (GR), Acquapendente (VT)) or humid with no summer drought (Piancastagnaio (SI) and S. Casciano dei Bagni (SI)) (see also BARAZZUOLI & al., 1993).

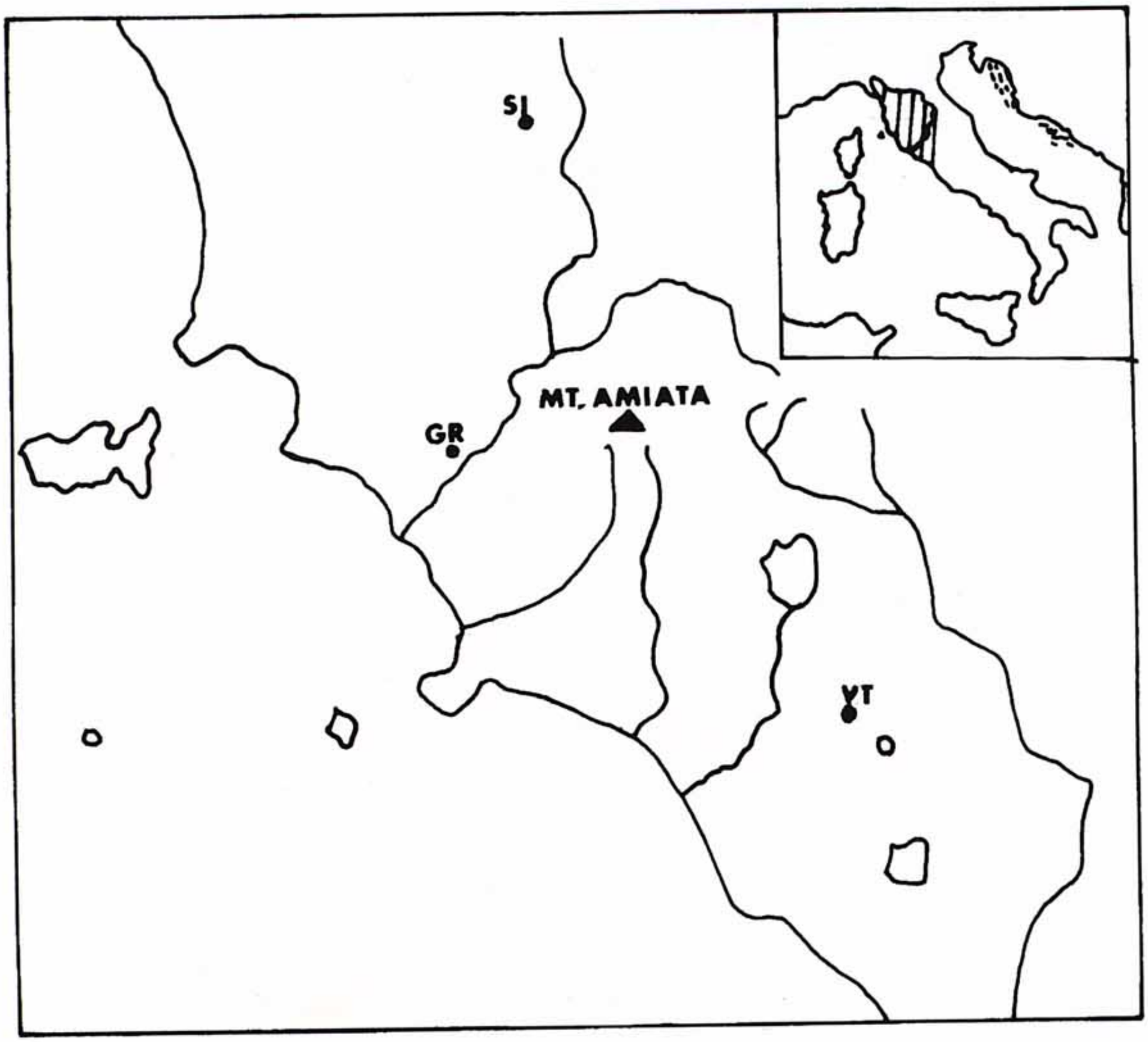

Fig. 1. The study area.

The main sedimentary formations (CALAMAI & al., 1970; GIANNINI & al., 1971; JACOBACCI & al., 1965) are: 1) marls and lacustrine clays of the calcareous siliceous Jurassic Group and Early Cretaceous (facies of the Group of Tuscan Formations); 2) Flysch-facies (Alberese-Pietraforte Group) including a cretaceous formation; 3) Neogenic formations consisting of Pliocenic clays.

Data analysis

Data of 86 stations chosen randomly along the watercourses (ditches, streams, rivers) were analyzed. Each station was characterized in terms of seven parameters, coded as reported in Table 1 for statistical analysis.

The stations were classified using the Syntax 5.0 software package (PODANI, 1993) on a 86 X 7 matrix. The excessive weight of the parameter 5 (altitude) with respect to the other parameters was reduced by expressing in terms of its logarithm. Cluster analysis was performed using the average link as clustering and percentage difference

PAR 1- Presence/absence of *Santolina etrusca*
1 absent
2 present
PAR 2 - Stream bed vegetation
1 dens shrub/tree vegetation
2 more or less shrubby garigue
PAR 3 - Stream bed characteristics
1 narrow
2 wide (~ 5 -100 m): silty-clayey
3 wide (~ 5 -100 m): stoney-sandy
PAR 4 - Watercourse regime
1 fluvial
2 intermittent
PAR 5 - Altitude
value in meters
PAR 6 - Exposure
1 N; 2 NE; 3 NW; 4 E; 5 W; 6 SE; 7 SW; 8 S
PAR 7 - Prevailing geology in the neighbourhoad of the station
1 no clear prevalent geology
2 quartz-latitic volcanites of Mt. Amiata
3 prevalent alternation of flysch-facies and Jurassic calcareous marl formation
4 facies of the Group of Tuscan Formations
5 Alberese-Pietraforte Group, flysch-facies
6 now prevalent flysch facies formations; previously Pliocene clay formations
7 Pliocene clays

Table 1. Environmental parameters coding for statistical analysis.

as dissimilarity index (see ORLOCI, 1978). Relationships between the environmental parameters and *S. etrusca* occurrence were expressed in terms of Spearman's non-parametric correlation coefficient using the Statistica 3.1 software package (STATSOFT INC., 1992).

Results

Classification

The dendrogram of the stations (Fig. 2) revealed three main clusters with the following features:

Cluster 1.- prevalence of clays, wide stoney-sandy stream bed, garigue, almost constant presence of *S. etrusca;* exposure falls into two subclusters (1a southern slopes, 1b northern slopes).

Cluster 2.- prevalence of flysch, southern exposure; two subclusters (2a with densely shrubby or tree covered stream bed and sporadic presence of *S. etrusca*, 2b with garigue and constant presence of *S. etrusca*);

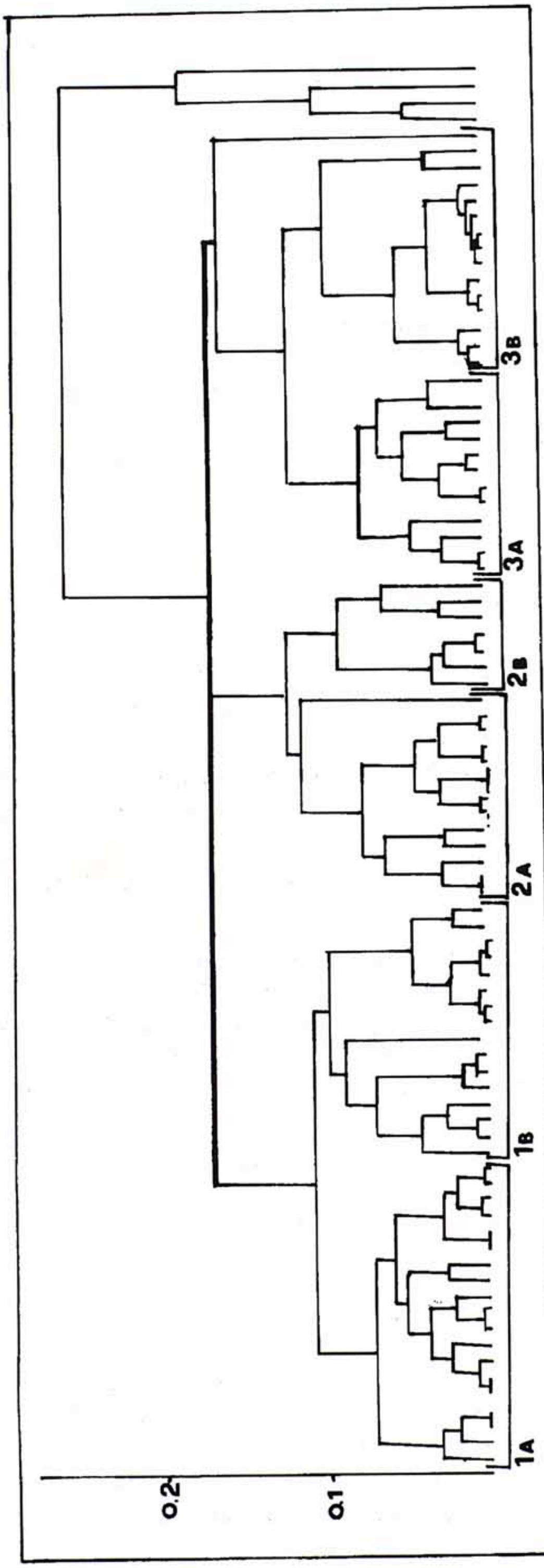

Fig. 2. The dendrogram of the stations.

Cluster 3.- narrow stream bed with plant cover, northern exposure; two subclusters (3a clays, 3b limestone) both without *S. etrusca*. Another small cluster included stations in flat sections of the rivers Orcia and Ombrone with *S. etrusca*, on wide stoney-sandy river bed with garigue, and stations without *S. etrusca* on open muddy-clayey river bed with riparian shrubs and/or trees.

Relationship between the environmental parameters and *S. etrusca* occurrence

The Spearman's non parametric correlation coefficient (Tab.2) showed a high correlation between presence of *S. etrusca*, garigue vegetation and wide clayey-stoney stream bed. A negative relationship was found between higher altitude and presence of the species, which is obviously due to fact that the higher elevations are positively correlated to a dens shrub/tree vegetation and a narrow stream bed. Such conditions are not favorable for *S. etrusca*.

Discussion and conclusions

The results of the present study show that the presence of *S. etrusca* along streams in the study area is closely related to wide stream beds with garigue and a very permeable sandy-stoney substrate.

These conditions are mostly found in the wide intermediate sections of the streams of the study area, where the stream bed forms terraces of sandy-pebbly deposits, disturbed occasionally by floods which cause erosion and new deposition. These terraces experience long periods of dryness, but the porous substrate allows deep rooting species like *S. etrusca* to reach strata kept moist by running water, or the aquifer when the stream is dry (most of the streams studied had a dry period in summer). In such situations, garigue establishes and *S. etrusca* achieves its maximum cover (ANGIOLINI & al., 1996). Optimum habitats for *S. etrusca* are not found in the initial sections of streams, which are generally fast, narrow and densely vegetated, or in the flat sections of the larger rivers (the Fiora, Ombrone and Paglia), which have muddy deposits and

	PAR. 1	PAR. 2	PAR. 3	PAR. 4	PAR. 5	PAR. 6	PAR. 7
PAR. 1	1.000						
PAR. 2	0.839**	1.000					
PAR. 3	0.664**	0.804**	1.000				
PAR. 4	-0.145	-0.120	-0.172	1.000			
PAR. 5	-0.413**	-0.438**	-0.460**	0.237*	1.000		
PAR. 6	0.163	0.150	-0.007	-0.204	-0.187	1.000	
PAR. 7	0.077	0.187	0.217*	0.140	-0.060	-0.159	1.000

Table 2. Spearman's non parametric correlation coefficients: Values statistically significant: (* = $p < 0.005$; **$p<0.001$).

a superficial aquifer that permit the success of more competitive species. The link found in the present study between this species and sandy-stoney margins of stream beds are in line with the observations of MONTELUCCI (1970) who found *S. etrusca* in non fluvial habitats only on very permeable soils, and those of ARRIGONI (1982) who noted the preference of this species for gravelly soils. The negative relation between altitude and *S. etrusca* is linked to the disappearance of appropriate fluvial habitats at higher altitudes (see negative correlation between altitude and wide stream beds with garigue in Table 2). This relation cannot be ascribed to differences in climate between higher and lower altitudes, as *S. etrusca* may be found up to about 800 m along loose stoney roadsides with open vegetation (ANGIOLINI & BOSCAGLI, unpublished data).

In conclusion, the present results give a clear picture of the ecology of *S. etrusca* in fluvial habitats, demonstrating that it is promoted by dryness and by deposits of gravelly material which preclude or limit the establishment of more exigent and competitive species. These observations are also in line with the chamaephytic habitus of *S. etrusca*.

References

ANGIOLINI, C., A. BOSCAGLI, B. FOGGI & A. SCOPPOLA (1996). Studio preliminare su ecologia e distribuzione di Santolina etrusca (Lacaita) Marchi et D'Amato. *Coll. Phitosoc.* **24**: 625-633.

ARRIGONI, P. V. (1979). Le genre Santolina en Italie. Webbia **34(1)**: 257-264.

—— (1982). Santolina etrusca (Lacaita) Marchi et D'Amato. In: *Guide-Itinéraire de l'Excursion Internationale de Phytosociologie en Italie centrale (2-11 juillet 1982)*. Camerino.

BARAZZUOLI, P., G. GUASPARRI & M. SALLEOLINI (1993). Il clima. In F. GIUSTI (ed.), *La storia naturale della Toscana Meridionale*: 141-171. A. Pizzi Editore, Cinisello Balsamo.

A. CALAMAI, R. CATALDI, P. SQUARCI & L. TAFFI (1970). *Geology, geophysics and hydrogeology of the Monte Amiata geothermal fields. I - Maps and comments. Special issue 1, Geothermics.*

GIANNINI, E., A. LAZZAROTTO & R. SIGNORINI (1971). Lineamenti di stratigrafia e di tettonica. In: La Toscana meridionale. *Rend. Soc. Ital. Mineral. Petrol.* **27 (Fasc. Spec.)**: 33-168.

JACOBACCI, A., N. MALFERRARI, G. MARTELLI, U. PERNO & G. NAPPI (1965). *Carta geologica díItalia: Foglio 129 - S. Fiora.* Serv. Geol. It. Napoli.

LACAITA, C. (1925). Piante italiane critiche o rare. *Nuovo Giorn. Bot. Ital., n.s.* **32**: 206-222.

MONTELUCCI, G. (1970). Sguardo alla vegetazione del travertino di Bassano in Teverina (Orte). *Webbia* **25(1)**: 53-101.

ORLÓCI, L. (1978). *Multivariate Analysis in Vegetation Research,* ed. 2. Junk. The Hague.

PODANI, J. (1993). *SYN-TAX-pc. Computer Programs for Multivariate Data Analysis in Ecology and Systematics. Version 5.0.* Scientia Publishing, Budapest.

STATSOFT INC. (1992). *STATISTICA reference for statistical procedures, version 3.1.* StatSoft inc., Tulsa, OK.

THORNTHWAITE, C. W. (1948). An approach toward a Rational Classification of Climate. *Geogr. Review* **38**: 55-94.

Address of the authors:

Dr. C. Angiolini & A. Boscagli, Dipartimento di Biologia Ambientale, Università di Siena, Via P. A. Mattioli 4, 53100 Siena, Italy.