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BREVI NOTE / SHORT NOTES

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SEASONAL OCCURRENCE AND ABUNDANCE OF DUNG BEETLES ON A SMALL MEDITERRANEAN ISLAND

Presenza e abbondanza stagionale di Scarabeoidei coprofagi in una piccola isola mediterranea

Introduction

Insect seasonality is mainly controlled by three factors: resource availability, temperature and rainfall (Wolda, 1978). Concerning the dung beetles, one of the larger and hyper-diverse groups of insects, seasonality has strong effect on their activity (Cambefort, 1991) and phenology is an important factor in structuring their assemblages, at least in temperate regions (Wassmer, 1994).

In the Mediterranean region, dung beetles have usually a peak of activity in spring, while another smaller peak occurs in autumn (see Lumaret & Kirk, 1987, 1991; Galante *et al.*, 1995). However, their occurrence and abundance may be influenced also by the lack of rain in midsummer and the low temperatures in midwinter (Ridsdill-Smith & Hall, 1984). Within this geographical context, structure and phenology of dung beetle communities have been studied mostly on continental areas (see for instance Lumaret & Kirk, 1987; Romero-Alcaraz & Ávila, 2000; Haloti *et al.*, 2006; Jay-Robert *et al.*, 2008; Errouissi *et al.*, 2009; Agoglitta *et al.*, 2012), while only few data are available for island environments (Lobo & Martín-Piera, 1993).

The aim of this study is to evaluate the changes in the structure and diversity of dung beetle assemblages in a small Mediterranean island through a year.

Material and Methods

The study area is located at "Cugni di Molinello" (38°23'47"N-14°58'45"E), in the central-eastern sector of Vulcano Island (Aeolian Archipelago, Sicily), at 320 m a.s.l. (Fig. 1). The site has a surface of about 2 ha and represents an ecotone between a reforested area with *Pinus* sp. pl. and *Eucalyptus* sp. pl. and the pastures that cover most part of the central flat plain of the island. In the study area a bovine livestock of about 50 individuals is constantly maintained. Local bioclimate belongs to the upper thermomediterranean thermotype and to dry-subhumid hombrotype. The average annual rainfall and temperature is, respectively 540-680 mm and 18.3 °C (Lo Cascio, 2017 and references therein).

The site was visited monthly from April 2009 to April 2010 (12 sessions), with the only exception of December, when fieldwork was prevented by adverse weather conditions. For each session,

Fig. 1 – The study site.

10 cattle dungs were choose randomly and sampled, collecting all the adults of Scarabaeoidea contained inside and/or occurring under the substrate (up to about 20 cm below). The direct collection was preferred over the placement of pit-fall traps, a standard method in this type of study (HANSKI, 1980; LOBO *et al*., 1988), due to the physical characteristics of the site and the impossibility of their constant monitoring.

All the collected specimens were identified at lab according to the keys given by BARAUD (1992), MARTÍN-PIERA & LÓPEZ-COLÓN (2000) and DELLACASA & DELLACASA (2006), and are kept in the author's collection. Systematic treatment (see Table 1) follows MARTÍN-PIERA & LÓPEZ-COLÓN (2000) for Geotrupidae and Scarabaeidae and DELLACASA & DELLACASA (2006) for Aphodiidae.

Similarity between months in species abundance was obtained through cluster analysis with paired group (UPGMA) based on Bray-Curtis coefficient, and performed using the free-access software PAST version 3.1.

RESULTS

A total of 2,528 specimens (71 Geotrupidae, 1,532 Aphodiidae and 925 Scarabaeidae), belonging to 23 species, have been collected during 12 monthly sessions (see Table 1). The average number of specimens for session is 183.5 (s.e. 27.0, s.d. 93.6). Two peaks of abundance occur in November (n = 438) and May (n = 344), while the minimum is recorded in January (n = 124). Although both partially absent in summer, *Paleonthophagus opacicollis* and *Aphodius fimetarius* dominate the assemblage in terms of number of specimens throughout the year (respectively equal to 18.4 and 14.6% of the total of collected specimens). The average number of species for session is 10.4 (s.e. 0.7, s.d. 2.6), with a maximum peak of species richness recorded in spring (n = 14 species, April and

Table 1
Monthly session with species occurrence and abundance.

	A	M	J	J	A	S	O	N	J	F	M	A	
Thorectes intermedius (O.G. Costa, 1839)						1	5						**6**
Sericotrupes niger (Marsham, 1802)		1	4	3	5	41	10	1					**65**
Alocoderus hydrochaeris (Fabricius, 1798)	3							1	2		1		**7**
Aphodius fimetarius (Linnaeus, 1758)	9	34	17				2	183	74	38	10	4	**371**
Aphodius foetidus (Herbst, 1783)	64	1					8	38			22	47	**180**
Bodiloides ictericus ssp. *ghardimaouensis* (Balthasar, 1929)		1	2		5	13	43						**64**
Calamosternus granarius (Linnaeus, 1767)	10						3		4	80	136	54	**287**
Chilothorax lineolatus (Illiger, 1803)	12	53						7	8	27	15	13	**135**
Colobopterus erraticus (Linnaeus, 1758)	2	29									3	21	**55**
Eurodalus tersus (Erichson, 1848)	13	1						1	2	10	23	35	**85**
Labarrus lividus (A.G. Olivier, 1789)		1		30	37	44	42					1	**155**
Mecynodes striatulus (Waltl, 1835)		1						3				5	**9**
Otophorus haemorrhoidalis (Linnaeus, 1758)	1	1	21	33	25	10							**91**
Subrinus sturmi (Harold, 1870)		1		19	54	8	1						**83**
Bubas bison (Linnaeus, 1767)	8						47	83	30	14	13	8	**203**
Copris cavolinii (Petagna, 1792)	4					2	11	6					**23**
Euoniticellus fulvus (Goeze, 1777)	2		16	11	1	3					1		**34**
Euoniticellus pallipes (Fabricius, 1781)			2	16	1	2							**21**
Onthophagus taurus (Schreber, 1759)	3	1	30	23	17	36						5	**115**
Palaeonthophagus opacicollis Reitter, 1893	9	217	61			1	6	113	4	20	15	20	**466**
Palaeonthophagus vacca (Linnaeus, 1767)	2	2	44	2				2			5	6	**63**
Scarabaeus sacer Linnaeus, 1758			7			1							**8**
Scarabaeus typhon (Fischer von Waldheim, 1823)			2										**2**
Total No. of individuals	**142**	**344**	**206**	**138**	**145**	**162**	**178**	**438**	**124**	**189**	**244**	**220**	**2528**
Total No. of species	**14**	**14**	**11**	**8**	**8**	**12**	**11**	**11**	**7**	**6**	**11**	**12**	**23**

May) and the lowest in February (n = 6). Cluster analysis (Fig. 2) shows the occurrence of two main seasonal groups, respectively characterized by winter-spring and summer phenology.

The assemblage is characterized by a slight prevalence of *r*-strategists (52.1%) compared to *K*-strategists (47.8%).

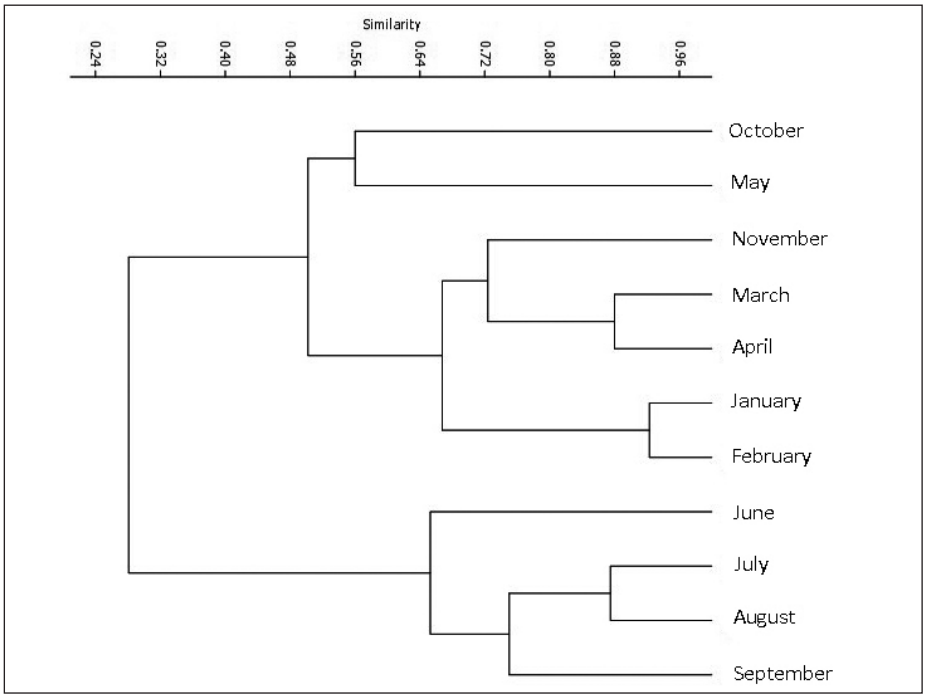

Fig. 2 – Dendrogram obtained by UPGMA clustering of species composition through the year, according to Bray-Curtis similarity coefficient.

Discussion

Vulcano is the only Aeolian island where the occurrence of large pastures allows the breeding of livestock, an activity existing since the 19th century when animals were even transported there from Sicily (Prestandrea & Calcara, 1854), and which still represents an important source for the local economy (Lo Cascio, 2017). It is not by chance, therefore, that within the archipelago this island hosts the greatest richness of dung beetles, with 35 species recorded (2 Geotrupidae, 17 Aphodiidae and 16 Scarabaeidae) (Habsburg Lothringen, 1894; Aliquò *et al.*, 1973; Palestrini, 1981; Zunino, 1981; Carpaneto, 1985; Dellacasa, 1987; Martín-Piera, 1987; Rastelli, 2000; Arnone *et al.*, 2001; Agoglitta *et al.*, 2006), nine of them [*Agrilinus ibericus* (Harold, 1874), *Calamosternus mayeri* (Pilleri, 1953), *Esymus merdarius* (Fabricius, 1775), *Eudolus quadriguttatus* (Herbts, 1783), *Trichonotulus scrofa* (Fabricius, 1787), *Cheironitis irroratus* (Rossi, 1790), *Palaeonthophagus fracticornis* (Preyssler, 1790), *Ateuchetus laticollis* (Linnaeus, 1767) and *A. semipunctatus* (Fabricius, 1792)] however not confirmed after 1990. Conversely, one of the collected species during the samples (*Subrinus sturmi*) is a new faunal record.

Phenological segregation seems to play an important role: a winter-spring group includes species such as *Aphodius foetidus*, *Calamosternus granarius*, *Chilothorax lineolatus*, *Colobopterus erraticus*, *Eurodalus tersus* and *Bubas bison*, while a larger summer group is composed by *Sericotrupes niger*, *Bodiloides ictericus*, *Labarrus lividus*, *Otophorus haemorrhoidalis*, *Subrinus sturmi*, *Euoniticellus fulvus*, *E. pallipes*, *Onthophagus taurus*, *Palaeonthophagus vacca* and *Scarabaeus sacer*. Anyhow, it should be noted that the maximum peak of species abundance is recorded in spring and equal to 14 species out of 23 (60%), while in other coastal environments (e.g. central Italian Peninsula) the cumulative annual richness is almost the same of the summer community richness (AGOGLITTA *et al*., 2012). The species composition is less characterized by a strong segregation or opposite patterns in dominant guilds (for instance, Aphodiinae-dwellers and Scarabaeidae-tunnelers) as observed in other Mediterranean areas (ERROUISSI *et al*., 2009).

According to ARNONE *et al*. (2001), who taken in consideration all the faunal data including the historical records, the partition between *r*- and *K*-strategists resulted strongly dominated by these latter; contrariwise, the samplings carried out during this research showed a slight prevalence of *r*-strategists, which can be interpreted as an indicator of a certain degree of disturbance or instability of the studied community.

Finally, some species participate to the assemblage only sporadically (such as *Alocoderus hydrochaeris*, *Mecynodes striatulus* and *Scarabaeus typhon*), or as casual member not strictly linked to this pabulum (*Thorectes intermedius*).

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