

## The diversity of flesh flies (Diptera: Sarcophagidae) on the southern slopes of three volcanoes within the Campi Flegrei (near Naples, Southern Italy)

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**A b s t r a c t :** The aim of this paper is to present a list of species of Sarcophagidae from the southern slopes of three volcanoes in the area of Campi Flegrei, near Naples, collected within three periods between 1 April and 2 July 2023. A total of 1161 specimens of Sarcophagidae, belonging to 38 species (5 Miltogramminae, 2 Paramacronychiinae and 31 Sarcophaginae) were collected. The most abundant species were *Sarcophaga (Sarcophaga) lehmanni* MÜLLER, 1922 (261 specimens), *S. (Heteronychia) siciliana* ENDERLEIN, 1928 (126 specimens) and *S. (Bercaea) africa* (WIEDEMANN, 1824) (90 specimens). The species *Sarcophaga (Heteronychia) tatrix* WHITMORE, 2011 and *S. (H.) mediterranea* WHITMORE, 2011 are new for Campania, have been rarely documented so far and can be considered as rarities of the Italian fauna.

**K e y w o r d s :** Sarcophagidae, Flesh flies, Campi Flegrei, Monte Nuovo, Monte Barbaro, Cratere Astroni, Pozzuoli, Naples, Southern Italy

### Introduction

The Sarcophagidae (flesh flies) contain about more than 2,500 species worldwide and about 800 species in the Palaearctic Region (PAPE 1996), of which about 190 have so far been found in Italy (WHITMORE 2010). They are present in both natural habitats and in habitats strongly influenced by humans (POVOLNÝ & VERVES 1997). Adults are commonly found basking in the sun on the ground, sand, wood, stones and rocks, less often on plants, but often on flowers for food intake, whereas the larvae show many different life strategies, ranging from parasitism and cleptoparasitism to necrophagy, coprophagy, saprophagy and predation, usually on small invertebrates, the large genus *Sarcophaga* especially on snails and earthworms (PAPE 1996). The nomenclature used follows PAPE (2004). Identifications were carried out using current keys for Sarcophagidae (PAPE 1987, POVOLNÝ & VERVES 1997, RICHET et al. 2011) and descriptions and illustrations in WHITMORE (2010, 2011), WHITMORE et al. (2013).

### Material and Methods

All flesh flies were caught exclusively with a hand net. From April to the beginning of May, this turned out to be easy, because on sunny paths the dark flies are easy to recognize against the light background. They are also active all day in the spring. However, in the summer they strictly avoided bare soil, sand and stones, where they were

almost impossible to find. They were then most likely to be captured on wooden fences, but even there only in the morning between 7.30 and 10 o'clock and in the later afternoon between 16 o'clock and 18.30. I did not find sarcophagids on flowers in the study area, although there would be numerous suitable plants available until the beginning of July (e.g. white-flowered umbellifers). On taller vegetation, I observed them only in vineyards on grape leaves in the morning hours (often females). Whether the abundance is actually lower in summer than in spring is difficult to judge. It is certain that at the end of June and beginning of July there are significantly fewer specimens and species to be observed. However, the percentage of female flies, which were not caught for identification reasons, significantly increased in the summer. Net sampling is time-consuming and energy-consuming, as many locations have to be visited again and again. The use of a Malaise trap would probably have brought greater success, but for various reasons it was not possible or not advisable in such proximity to the city of Naples. Accumulations on hilltops, typical for male sarcophagids, could only be detected at the Cratere Astroni.

### Study area

The Campi Flegrei, the "Burning Fields" were recently in the headlines. According to experts, this largest active European supervolcano is heading for a possible eruption that would have catastrophic consequences not only for the area around Naples. The Campi Flegrei, with its more than 50 eruption foci, extend over an area of more than 150 km<sup>2</sup>. They begin about 20 km west of Mount Vesuvius on the western outskirts of Naples, continue along the coast of the Mediterranean Sea and the Gulf of Naples, and in the south include the islands of Ischia, Procida and Nisida. The center is the town of Pozzuoli. In addition to the most conspicuous and dangerous part today, the largely vegetation-free Solfatara, which is characterized by constant gas leaks and smoke, the area is distinguished by numerous inactive volcanoes covered in lush vegetation. The southern slopes of three of these volcanoes were studied in three periods from April to early July, to document the fauna of the flesh flies living there.

#### 1 Monte Nuovo (Figs 1-5)

(Lucrino, municipality of Pozzuoli, W Napoli, 40.83N/14.09E)

The Monte Nuovo is a regularly formed, now inactive volcano in the area of the Campi Flegrei with a diameter of 1250 m at the base and about 140 m high. As the youngest mountain in Europe, it was formed by a volcanic eruption on September 29, 1538. The southern slope on the outside of the crater is covered with Mediterranean maquis (Macchia), only partially covered with pine forest, and a small area is also covered with garrigue, which is still in a steppe state, since the southern slope has been repeatedly hit by fires (last fire: 23.2.2019).

Typical plants of the maquis on the lime-free sandy soil are *Arbutus unedo*, *Cistus salvifolius*, *Erica arborea*, *Genista* sp., *Myrtus communis*, *Phillyrea latifolia*, *Pistacia lentiscus* and *Quercus ilex*. Plants such as *Echium plantagineum*, *Lupinus angustifolius*, *Vicia villosa*, *Galactites tomentosa*, *Urospermium dalechampii*, *Dittrichia viscosa*, *Asparagus acutifolius*, *Bituminaria bituminosa*, *Spartium junceum*, *Serapias lingua* etc. settle between the shrubs of the maquis and on their edges. The southern slope is crossed by several paths, and at the base of the mountain a wider sidewalk cuts through the maquis. There are rocky steep slopes above and below the path, also with vegetation similar to the maquis. At the crater rim, a circular path leads around the crater.



**Figs 1-4:** (1) Lucrino, Monte Nuovo, southern slope, maquis, habitat of *Sarcophaga (Heteronychia) siciliana*. (2) Lucrino, Monte Nuovo, southern slope, maquis. (3) Lucrino, Monte Nuovo, maquis of the southern slope. Flesh flies could be found on the sandy path only in spring. (4) Fly-catching with a net on Monte Nuovo.



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**Figs 5-9:** (5) Lucrino, Monte Nuovo, the wooden fence is the preferred seat of the culturophilous species *Sarcophaga (Liosarcophaga) dux*, *S. (L.) tibialis* and *S. (Bercaea) africa*. (6) Pozzuoli, Monte Barbaro, seen from Monte Nuovo. (7) Agnano, Cratere Astroni, species-rich hilltop above the vineyards. (8) Agnano, Cratere Astroni, southern slope covered with vineyards. (9) Pozzuoli, Monte Barbaro, southern slope. The path is hardly accessible in summer.



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The maquis on the southern slope of Monte Nuovo is populated en masse by Italian wall lizards (*Podarcis sicula*). It is not clear to what extent flies play a role as prey. Although I have been able to observe lizards snapping for flies several times, I have never noticed them succeeding in catching them.

## 2 Monte Barbaro (Monte Gauro) (Figs 6-7)

(Pozzuoli, W Napoli, 40.84N/14.10E)

The southern part of the Monte Gauro volcano bears the name Monte Barbaro. It reaches an altitude of about 300 m. Like the southern slope of Monte Nuovo, the southern slope of Monte Barbaro is also regularly affected by fires (e.g. 2013, 2019, 2022). The cultural terraces of this steep slope, partly interrupted by larger boulders and rock walls, are still clearly recognizable as such today, despite being abandoned since long time ago, and overgrown with dense vegetation. Lush, tall stands of perennials thrive on the sandy, fertile soils, which apparently have an increased water capacity. Many Fabaceae (especially clover species and peas), tall grasses and thistles line the rarely trodden path, shrubs and higher plants of the maquis are almost completely absent. Only a few juvenile downy oaks (*Quercus pubescens*) hold their own against this now dense vegetation of blossoms in mid-April. These are mainly wayside and ruderal plants such as *Ferula communis*, *Cerintho major*, *Lupinus angustifolius*, *Bituminaria bituminosa*, *Spartium junceum*, *Galactites tomentosa*, *Asparagus acutifolius*, *Echium plantagineum* etc. In the middle section of the slope the path leads through a downy oak (*Quercus pubescens*) forest; in the uppermost part, strangely enough, the pile pipe *Arundo donax* dominates, which quickly brings every insect life to a standstill.

## 3 Cratere degli Astroni (Figs 8-9)

(Agnano, Napoli, 40.83N/14.15E)

The inside of the crater of the volcano is now a nature reserve. The southern slope of the outer side of the crater is cultivated land. The slope carries intact wine crops on several terraces, which were being treated with pesticides (fungicides?) at the end of April. There are some chicken farms in the summit area. On the steps of the terraces, wayside plants and arable weeds (e.g. *Glebionis segetum*) grow between the wine crops on lime-free sandy soils. At the highest point of the crater rim, at 140 m a.s.l., a meadow area with freshly mown hay acts as an attractive hilltop.

## Results

### 1 Monte Nuovo (Tab. 1)

The paths that cross the southern slope of the Monte Nuovo are often frequented by walkers with dogs, the nutrient input is greatly increased here, which should also be expressed by a special sarcophagid fauna. The path at the crater rim has several sand spots, devoid of vegetation, which strangely enough do not exert any hilltop effect on the male *Sarcophaga* species. But no flesh flies were detected. In general, flesh flies were most abundant on the lowest parts of the maquis slope. In April, the natural sandy paths and the paved gravel paths for sunbathing are frequented by male *Sarcophaga* species;

small rocks, trees and especially the wooden steps of the paths are also used; the vegetation, on the other hand, is largely avoided by the flies. At the end of May and beginning of June, the flesh flies avoid the vegetation-free sandy soils and the paths where they were easy to discover. They are now more likely to sit in the short grass and are harder to see. They avoid higher vegetation. Only in the morning hours from 7.30 to 11 o'clock and in the afternoon from 15 to 17.30 they also sunbathe on stones on the paths and sit on sunlit wooden fences along the wide path of the maquis. Between 12 and 14 o'clock the activity of the flesh flies decreases significantly. Almost only Bombyliidae and syrphids venture into the blazing sun. At the same time, the air temperature still remains relatively modest at 24 degrees, the humidity is very high, but the intense UV sunlight may be decisive. At the end of June and the beginning of July, sarcophagids are no longer found on the trails, between 10 and 16 o'clock the activity of the flies almost completely subsides. In the morning and in the evening, on the contrary, they sunbathe on wooden fences and walls. In higher areas of the foot of the mountain, where they were still noticeable in the spring, they are apparently completely absent in the hot season.

The dominant fly of the first weeks of April in the maquis is the seedcorn maggot *Delia platura* (Anthomyiidae), which occurs en masse in the semi-shaded areas of the trails. Especially on the crater rim the calliphorid *Calliphora vicina*, several *Lucilia* and syrphid species dominate. At the end of May and beginning of June, the delicate anthomyiids and *Calliphora vicina* almost completely disappear, the very abundant *Lucilia sericata*, attracted by the excrements of dogs, dominates together with various species of flesh flies.

By far the most abundant flesh fly in spring is *Sarcophaga (Sarcophaga) lehmanni*, the frequency of which, however, decreases sharply with the increasing heat of the summer. While 144 individuals were caught in April, 36 were collected at the beginning of June and only 2 at the beginning of July. *Sarcophaga (Heteronychia) siciliana*, which can often be observed within the maquis in April, may possibly be considered a typical species of the maquis. However, it is not limited to the maquis. Also in the small village of Lucrino it was found on the concrete walls bordering the paths. This species, which was also quite abundant in April with 51 specimens, appears only rarely in summer (4 specimens at the beginning of June, 1 specimen at the beginning of July). The same applies to *Sarcophaga (Helicophagella) hirticrus*, which was completely absent in the summer. The occurrence of the rare species (for Campi Flegrei) *Sarcophaga (Heteronychia) amita*, *S. (Heteronychia) mediterranea* and *S. (Heteronychia) tatrix* is also limited to the spring and they can no longer be found in the summer. On the other hand, the occurrence of the culturophilous species *Sarcophaga (Bercaea) africa* (Fig. 10) remained constant throughout the study period. *Sarcophaga (Helicophagella) melanura*, *S. (Liosarcophaga) dux* and *S. (Liosarcophaga) tibialis* were clearly more typical summer species.







## 2 Monte Barbaro (Tab. 2)

In April, *Sarcophaga (Heteronychia) siciliana* dominates, and like all small *Sarcophaga* species, largely avoids the bare sandy soil of the paths and prefers shiny leaves at knee height as a place for sunbathing. *Sarcophaga (Sarcophaga) lehmanni* dominates in the downy oak forest. At the end of May and the beginning of June, big species like *S. (S.) lehmanni* largely disappear. The small species *Sarcophaga (Myorhina) socrus* and *S. (M.) nigriventris*, one can notice on the ruin walls at the crater rim and on bushes growing between the ruins. *Sarcophaga (Heteronychia) bulgarica* and *S. (Liosarcophaga) teretirostris* (Fig. 32) can be considered as special features of Monte Barbaro, *S. (L.) teretirostris* was quite abundant with 18 specimens. Since the highest point of the crater rim was not accessible due to the impenetrable vegetation, a hilltop function could be ruled out there. The few, heavily sunlit places of the path and the concrete access road in the lower part of the mountain were absolutely free of flesh flies at the end of May; even in the oak forest one could only occasionally notice flies, only some specimens were sitting on foliage on the cooler edge of the forest. The accompanying vegetation had already reached a height of 2.5 m on the southern slope, the path was barely recognizable and difficult to pass. It is unlikely that the flesh flies could be found in the upper area of the towering vegetation, which was at that time blooming in full splendor. Now the Hymenoptera dominated. At the beginning of July, another ascent of the mountain was waived. The path through the lush vegetation, which was hardly frequented in the spring, may now have become completely overgrown and even more difficult to pass. Since I had recently suffered a severe allergic reaction to a wasp sting, I wanted to avoid the danger from the numerous Hymenoptera in this sea of flowers.

**Tab. 2:** Species and numbers of specimens on Monte Barbaro.

	MB 24.4.	MB 28.4.	MB 29.4.	MB 30.5.	
MILTOGRAMMINAE					
<i>Amobia signata</i> (MEIGEN, 1824)	1				1
PARAMACRONYCHIINAE					
<i>Sarcophila latifrons</i> (FALLÉN, 1817)	1				1
SARCOPHAGINAE					
<i>Sarcophaga (Bercaea) africa</i> (WIEDEMANN, 1824)	4		2		6
<i>Sarcophaga (Helicophagella) hirticrus</i> PANDELLÉ, 1896	6	2	3		11
<i>Sarcophaga (Helicophagella) novella</i> BARANOV, 1929	5	3	2		10
<i>Sarcophaga (Heteronychia) bulgarica</i> (ENDERLEIN, 1936)	1	1			2
<i>Sarcophaga (Heteronychia) ferox</i> VILLENEUVE, 1908				1	1

	MB 24.4.	MB 28.4.	MB 29.4.	MB 30.5.	
<i>Sarcophaga (Heteronychia) filia</i> RONDANI, 1860	4		6		10
<i>Sarcophaga (Heteronychia) haemorrhoea</i> MEIGEN, 1826	1				1
<i>Sarcophaga (Heteronychia) siciliana</i> ENDERLEIN, 1928	18	11	26	14	69
<i>Sarcophaga (Liopygia) crassipalpis</i> MACQUART, 1839			1		1
<i>Sarcophaga (Liosarcophaga) dux</i> THOMSON, 1869		1			1
<i>Sarcophaga (Liosarcophaga) teretirostris</i> PANDELLÉ, 1896	5	4	8	1	18
<i>Sarcophaga (Myorhina) nigriventris</i> MEIGEN, 1826	1			13	14
<i>Sarcophaga (Myorhina) socrus</i> RONDANI, 1860				6	6
<i>Sarcophaga (Rosellea) aratrix</i> PANDELLÉ, 1896			1		1
<i>Sarcophaga (Sarcophaga) croatica</i> BARANOV, 1941	2			1	3
<i>Sarcophaga (Sarcophaga) lehmanni</i> MÜLLER, 1922	36	10	15		61
<i>Sarcophaga (Thyrsoxema) incisilobata</i> PANDELLÉ, 1896	10	4	6	1	21

### 3 Cratere Astroni (Tab. 3)

At the end of April and the beginning of May, syrphids and asilids dominate the southern slope occupied by vineyards (en masse the small *Machimus laciniatus*). At the highest point of the crater rim, at 140 m a.s.l., a meadow area with freshly mown hay acted as an attractive hilltop. At the beginning of June, numerous flesh flies were observed sunbathing on grape leaves at the foot of the mountain in the early morning hours, and had completely disappeared by noon. The hilltop at the highest point of the crater rim was still highly attractive to the flesh flies of the vineyards until the midday hours. It is rather unlikely that flies from the deep-shaded *Quercus ilex* forest to the north, which lies in the shadowy inner rim of the crater, would also have made their way to this place. So most flies came probably from the vineyards and the ruderal corridors or arable weed plant communities lying between them. At the beginning of June, the proportion of females was extremely high for a hilltop at about 20%, and remained so until the beginning of July. On the 30th of June, a hot, dry day, the hilltop hardly attracted sarcophagids. Not even in the favorable morning hours were they seen in significant numbers. Two days later, on July 2, after a night with rain and slightly cooler morning temperatures, a higher abundance can be observed again, which was also augmented by dog feces, which certainly increased the attractiveness of this hilltop significantly (dominant species were *Sarcophaga (Liosarcophaga) tibialis* (Fig. 33) and the calliphorid *Lucilia sericata*).

The vineyards of Cratere Astroni were characterized by the very frequent occurrence of *Sarcophaga (Helicophagella) novella* (Fig. 11), *S. (Heteronychia) consanguinea* (Fig. 13), *S. (H.) minima* and *S. (Liosarcophaga) tibialis*. *Sarcophaga (Heteronychia) ferox*

and *S. (H.) haemorrhoea* also had their distribution focus here, and *S. (H.) vagans* was only observed here. *Sarcophaga (Heteronychia) siciliana*, which was extremely abundant in the other two, more natural habitats, remained extremely rare in the vineyards with only one find.

**Tab. 3:** Species and numbers of specimens on Cratere Astroni.

	CA 27.4.	CA 31.5.	CA 2.6.	CA 30.6.	CA 2.7.	
MILTOGRAMMINAE						
<i>Metopia argyrocephala</i> (MEIGEN, 1824)			2			2
<i>Miltogramma testaceifrons</i> (VON ROSER, 1840)				2		2
<i>Senotainia albifrons</i> (RONDANI, 1859)				2	1	3
PARAMACRONYCHIINAE						
<i>Nyctia halterata</i> (PANZER, 1798)		1				1
<i>Sarcophila latifrons</i> (FALLÉN, 1817)		1	2		4	7
SARCOPHAGINAE						
<i>Ravinia pernix</i> (HARRIS, 1780)				2	1	3
<i>Sarcophaga (Bercaea) africa</i> (WIEDEMANN, 1824)	2		1			3
<i>Sarcophaga (Helicophagella) hirticrus</i> PANDELLÉ, 1896	1	4	5	1		11
<i>Sarcophaga (Helicophagella) melanura</i> MEIGEN, 1826	1	5	9	1	11	27
<i>Sarcophaga (Helicophagella) novella</i> BARANOV, 1929	22	23	12			57
<i>Sarcophaga (Heterionychia) amita</i> RONDANI, 1860	1	1	1			3
<i>Sarcophaga (Heteronychia) consanguinea</i> RONDANI, 1860	16	13	18	1	1	49
<i>Sarcophaga (Heteronychia) ferox</i> VILLENEUVE, 1908	2	3	7			12
<i>Sarcophaga (Heteronychia) filia</i> RONDANI, 1860			5			5
<i>Sarcophaga (Heteronychia) haemorrhoea</i> MEIGEN, 1826		9	10	2		21
<i>Sarcophaga (Heteronychia) minima</i> RONDANI, 1862	7	22	9	3	1	42
<i>Sarcophaga (Heteronychia) siciliana</i> ENDERLEIN, 1928		1				1
<i>Sarcophaga (Heteronychia) vagans</i> MEIGEN, 1826		2				2
<i>Sarcophaga (Liopygia) argyrostoma</i> (ROBINEAU-DESVOIDY, 1830)			2		1	3
<i>Sarcophaga (Liopygia) crassipalpis</i> MACQUART, 1839			3		2	5

	CA 27.4.	CA 31.5.	CA 2.6.	CA 30.6.	CA 2.7.	
<i>Sarcophaga (Liosarcophaga) dux</i> THOMSON, 1869			1			1
<i>Sarcophaga (Liosarcophaga) portschinskyi</i> (ROHDENDORF, 1937)				1		1
<i>Sarcophaga (Liosarcophaga) tibialis</i> MACQUART, 1851	1	5	8	14	23	51
<i>Sarcophaga (Myorhina) nigriventris</i> MEIGEN, 1826		10	4			14
<i>Sarcophaga (Parasarcophaga) albiceps</i> MEIGEN, 1826	1		2	2		5
<i>Sarcophaga (Sarcophaga) croatica</i> BARANOV, 1941	2		1		1	4
<i>Sarcophaga (Sarcophaga) lehmanni</i> MÜLLER, 1922	8		3	3	4	18
<i>Sarcophaga (Thyrsoctema) incisilobata</i> PANDELLÉ, 1896				1		1

In the area of the Campi Flegrei, 1161 specimens of Sarcophagidae were found, belonging to 38 species (Table 4). The abundance of species and individuals decreased continuously from April to July with the increasing heat, although the study period in April was much longer than in the following two months. For example, 25 species were found at Monte Nuovo from April to the beginning of May, 17 species at the beginning of June and only 13 species at the beginning of July. In the vineyards of Cratere Astroni, 23 species were counted at the end of June and only 17 species at the end of July. At Monte Barbaro, 17 species were documented in April and only 7 at the end of May.

Among the psammophilic satellite flies of the Miltogramminae, *Miltogramma testaceifrons* was dominant, but did not appear before June. The dominant parasitoid of earthworms and the most common flesh fly of the maquis on Monte Nuovo and the oak forest on Monte Barbaro was *Sarcophaga (Sarcophaga) lehmanni*, whereas *S. (S.) croatica* (Figs 34-35) only occurred sporadically everywhere and did not appear before the end of April. Since the studied habitats of the Campi Flegrei are surrounded by densely populated residential areas, the proportion of synanthropic, culturophilous, usually also significantly thermophilic species was high. These include species such as *Sarcophaga (Bercaea) africa*, *S. (Helicophagella) melanura*, *S. (Liopygia) argyrostoma* (Fig. 26), *S. (Liopygia) crassipalpis* (Fig. 27), *S. (Liosarcophaga) portschinskyi* (Figs 30-31), *S. (Liosarcophaga) tibialis*, *S. (Parasarcophaga) albiceps*, *S. (Rosellea) aratrix* and *S. (Thyrsoctema) incisilobata*. Certainly, the common *S. (Liosarcophaga) dux*, the biology of which little is still known, also belongs to this group.

**Table 4:** Species and numbers of specimens on the volcanoes Monte Nuovo, Monte Barbaro and Cratere Astroni.

	Monte Nuovo	Monte Barbaro	Cratere Astroni
MILTOGRAMMINAE			
<i>Amobia signata</i> (MEIGEN, 1824)	1	1	
<i>Metopia argyrocephala</i> (MEIGEN, 1824)			2
<i>Miltogramma iberica</i> VILLENEUVE, 1912	1		
<i>Miltogramma testaceifrons</i> (VON ROSER, 1840)	6		2
<i>Senotainia albifrons</i> (RONDANI, 1859)	1		3
PARAMACRONYCHIINAE			
<i>Nyctia halterata</i> (PANZER, 1798)	1		1
<i>Sarcophila latifrons</i> (FALLÉN, 1817)	5	1	7
SARCOPHAGINAE			
<i>Ravinia pernix</i> (HARRIS, 1780)	1		3
<i>Sarcophaga (Bercaea) africa</i> (WIEDEMANN, 1824)	81	6	3
<i>Sarcophaga (Helicophagella) hirticrus</i> PANDELLÉ, 1896	19	11	11
<i>Sarcophaga (Helicophagella) melanura</i> MEIGEN, 1826	31		27
<i>Sarcophaga (Helicophagella) novella</i> BARANOV, 1929	4	10	57
<i>Sarcophaga (Heteronychia) amita</i> RONDANI, 1860	1		3
<i>Sarcophaga (Heteronychia) bulgarica</i> (ENDERLEIN, 1936)		2	
<i>Sarcophaga (Heteronychia) consanguinea</i> RONDANI, 1860	1		49
<i>Sarcophaga (Heteronychia) ferox</i> VILLENEUVE, 1908	3	1	12
<i>Sarcophaga (Heteronychia) filia</i> RONDANI, 1860	4	10	5
<i>Sarcophaga (Heteronychia) haemorrhoea</i> MEIGEN, 1826		1	21
<i>Sarcophaga (Heteronychia) mediterranea</i> WHITMORE, 2011	2		
<i>Sarcophaga (Heteronychia) minima</i> RONDANI, 1862	7		42
<i>Sarcophaga (Heteronychia) proxima</i> RONDANI, 1860	2		
<i>Sarcophaga (Heteronychia) siciliana</i> ENDERLEIN, 1928	56	69	1

	Monte Nuovo	Monte Barbaro	Cratere Astroni
<i>Sarcophaga (Heteronychia) tetrax</i> WHITMORE, 2011	1		
<i>Sarcophaga (Heteronychia) vagans</i> MEIGEN, 1826			2
<i>Sarcophaga (Liopygia) argyrostoma</i> (ROBINEAU-DESVOIDY, 1830)	23		3
<i>Sarcophaga (Liopygia) crassipalpis</i> MACQUART, 1839	6	1	5
<i>Sarcophaga (Liosarcophaga) dux</i> THOMSON, 1869	48	1	1
<i>Sarcophaga (Liosarcophaga) portschinskyi</i> (ROHDENDORF, 1937)	2		1
<i>Sarcophaga (Liosarcophaga) teretirostris</i> PANDELLÉ, 1896		18	
<i>Sarcophaga (Liosarcophaga) tibialis</i> MACQUART, 1851	18		51
<i>Sarcophaga (Myorhina) nigriventris</i> MEIGEN, 1826	2	14	14
<i>Sarcophaga (Myorhina) socrus</i> RONDANI, 1860		6	
<i>Sarcophaga (Pandelleana) protuberans</i> PANDELLÉ, 1896	22		
<i>Sarcophaga (Parasarcophaga) albiceps</i> MEIGEN, 1826	7		5
<i>Sarcophaga (Rosellea) aratrix</i> PANDELLÉ, 1896		1	
<i>Sarcophaga (Sarcophaga) croatica</i> BARANOV, 1941	18	3	4
<i>Sarcophaga (Sarcophaga) lehmanni</i> MÜLLER, 1922	182	61	18
<i>Sarcophaga (Thyrsoxema) incisilobata</i> PANDELLÉ, 1896	13	21	1

### Discussion

Species of the Mediterranean faunal element were *Sarcophaga (Heteronychia) amita* (Fig. 12), *S. (Heteronychia) consanguinea*, *S. (Heteronychia) ferox* (Fig. 14), *S. (Heteronychia) filia*, *S. (Heteronychia) mediterranea* (Figs 15-18), *S. (Heteronychia) minima* (Fig. 19), *S. (Heteronychia) siciliana* (Figs 20-22), *S. (Heteronychia) tetrax* (Figs 23-25), *S. (Liosarcophaga) tibialis*, *S. (Liosarcophaga) dux* (Figs 28-29) and *S. (Sarcophaga) croatica*. *Sarcophaga (Pandelleana) protuberans* is also considered to be clearly thermophilic.

Also widespread in Central Europe, partly mesophilic or forest-loving species were *Nyctia halterata*, *Sarcophila latifrons*, *Sarcophaga (Heteronychia) bulgarica*, *S. (Heteronychia) haemorrhoea*, *S. (Heteronychia) vagans*, *S. (Rosellea) aratrix*, *S. (Sarcophaga) lehmanni* and *S. (Thyrsoxema) incisilobata*.

## Appendix

Other identified fly species at Campi Flegrei from various fly families (without any claim to completeness, which definitely applies also to the Sarcophagidae)

### Asilidae:

- Cerdistus erythrurus* (MEIGEN, 1820)  
*Holopogon nigripennis* (MEIGEN, 1820)  
*Machimus fimbriatus* (MEIGEN, 1804)  
*Machimus lacinulatus* LOEW, 1854 (very common)  
*Saropogon luctuosus luctuosus* (WIEDEMANN, 1820)

### Bombyliidae:

- Exoprosopa jacchus* (FABRICIUS, 1805)  
*Phthiria gaedii* WIEDEMANN, 1820  
*Phthiria umbripennis* LOEW, 1846

### Therevidae:

- Thereva plebeja* (LINNAEUS, 1758)

### Sepsidae:

- Sepsis lateralis* WIEDEMANN, 1830

### Anthomyiidae:

- Anthomyia pluvialis* (LINNAEUS, 1758)  
*Anthomyia quinque maculata* MACQUART, 1839 (very common)  
*Delia bracata* (RONDANI, 1866)  
*Delia platura* (MEIGEN, 1826) (very common in spring)  
*Delia radicum* (LINNAEUS, 1758)  
*Emmesomyia socia* (FALLÉN, 1825)  
*Lasiomma seminitidum* (ZETTERSTEDT, 1845)

### Fanniidae:

- Fannia canicularis* (LINNAEUS, 1761)

### Muscidae:

- Hebecnema vespertina* (FALLÉN, 1823)  
*Helina evecta* (HARRIS, 1780)  
*Helina reversio* (HARRIS, 1780)  
*Hydrotaea ignava* (HARRIS, 1780)  
*Musca domestica* LINNAEUS, 1758 (very common)  
*Muscina prolapsa* (HARRIS, 1780)  
*Muscina stabulans* (FALLÉN, 1817)  
*Phaonia laeta* (FALLÉN, 1823)  
*Phaonia trimaculata* (BOUCHE, 1834)

### Calliphoridae:

- Bellardia pruinosa* (ENDERLEIN, 1933)

*Calliphora vicina* ROBINEAU-DESVOIDY, 1830 (very common)

*Chrysomya albiceps* (WIEDEMANN, 1819)

*Lucilia ampullacea* VILLENEUVE, 1922

*Lucilia caesar* (LINNAEUS, 1758)

*Lucilia sericata* (MEIGEN, 1826) (very common on feces)

*Stomorhina lunata* (FABRICIUS, 1805) (common in spring)

Polleniidae:

*Pollenia angustigena* WAINWRIGHT, 1940

*Pollenia paupera* RONDANI, 1862 (common in spring)

Rhinophoridae:

*Oplisa tergestina* (SCHINER, 1862) (common)

*Phyto adolescens* RONDANI, 1861

*Phyto melanocephala* (MEIGEN, 1824)

*Stevenia deceptorica* (LOEW, 1847) (common)

*Stevenia obscuripennis* (LOEW, 1847) (common)

Tachinidae:

*Exorista nympharum* (RONDANI, 1859)

*Gymnosoma clavatum* (ROHDENDORF, 1947)

*Macquartia tessellum* (MEIGEN, 1824) (common)

*Meigenia dorsalis* (MEIGEN, 1824)

*Microphthalma europaea* EGGER, 1860

*Ocytata pallipes* (FALLÉN, 1820)

*Peleteria rubescens* (ROBINEAU-DESVOIDY, 1830)

*Periscepsia carbonaria* (PANZER, 1798)

*Voria ruralis* (FALLÉN, 1810)

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## Zusammenfassung

Ziel dieser Arbeit ist es, eine Artenliste der Fleischfliegen an den Südhängen von drei Vulkanen im Bereich der Campi Flegrei bei Neapel innerhalb von drei Untersuchungsperioden zwischen 1. April und 2. Juli 2023 zu präsentieren. Es wurden insgesamt 1161 Exemplare der Sarcophagidae gesammelt, die zu 38 Arten gehören (5 Miltogramminae, 2 Paramacronychiinae und 31 Sarcophaginae). Die häufigsten Arten waren *Sarcophaga (Sarcophaga) lehmanni* MÜLLER, 1922 (261 Exemplare), *S. (Heteronychia) siciliana* ENDERLEIN, 1928 (126 Exemplare) und *S. (Bercaea) africa* (WIEDEMANN, 1824) (90 Exemplare). Die Arten *Sarcophaga (Heteronychia) tetrix* WHITMORE, 2011 und *S. (H.) mediterranea* WHITMORE, 2011 sind Neunachweise für Kampanien, wurden bisher nur selten dokumentiert und können als Raritäten der italienischen Fauna gelten.

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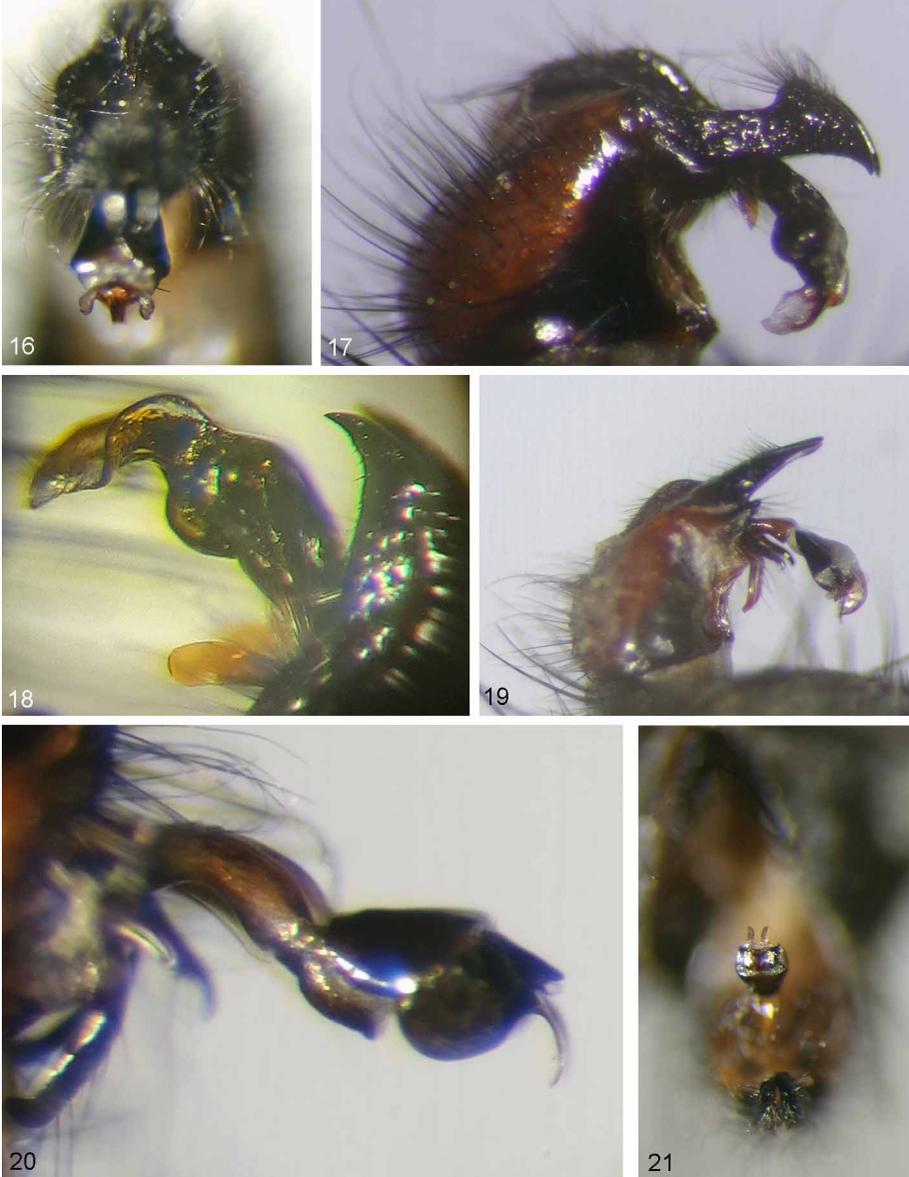
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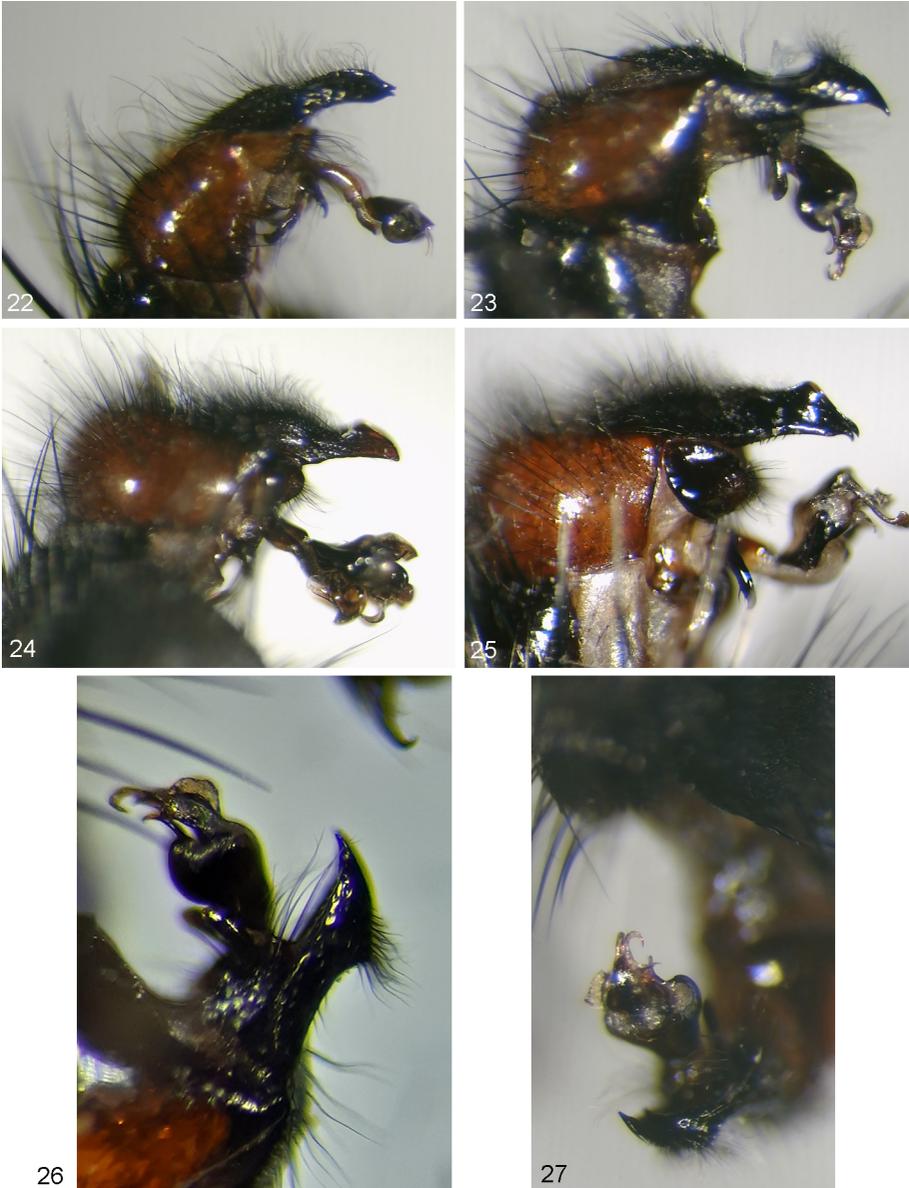
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**Figs 10-15:** (10) *Sarcophaga (Bercaea) africa* (WIEDEMANN, 1824), Monte Nuovo, 1.6.2023, male terminalia; (11) *Sarcophaga (Helicophagella) novella* BARANOV, 1929, Cratere Astroni, 31.5.2023, male terminalia; (12) *Sarcophaga (Heteronychia) amita* (RONDANI, 1860), Cratere Astroni, 31.5.2023, male terminalia; (13) *Sarcophaga (Heteronychia) consanguinea* RONDANI, 1860, Cratere Astroni, 31.5.2023, male terminalia; (14) *Sarcophaga (Heteronychia) ferox* VILLENEUVE, 1908, Monte Barbaro, 30.5.2023, male terminalia; (15) *Sarcophaga (Heteronychia) mediterranea* WHITMORE, 2011, Monte Nuovo, 29.5.2023, distiphallus semi-lateral.



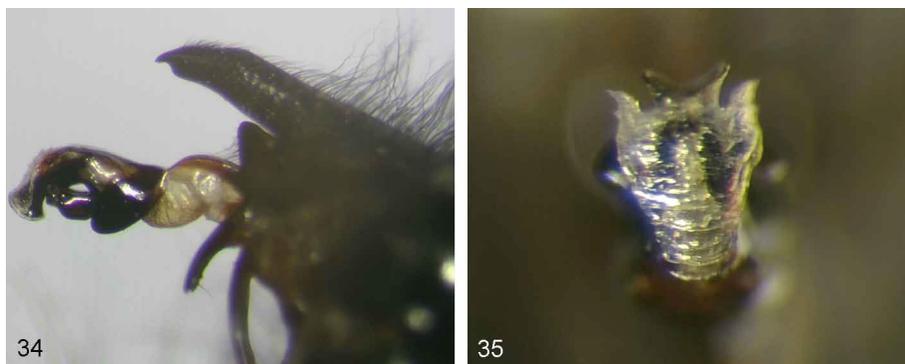
**Figs 16-21:** (16) *Sarcophaga (Heteronychia) mediterranea* WHITMORE, 2011, Monte Nuovo, 29.5.2023, distiphallus dorsal; (17) *Sarcophaga (Heteronychia) mediterranea* WHITMORE, 2011, Monte Nuovo, 29.5.2023, male terminalia; (18) *Sarcophaga (Heteronychia) mediterranea* WHITMORE, 2011, Monte Nuovo, 29.5.2023, phallus lateral; (19) *Sarcophaga (Heteronychia) minima* RONDANI, 1862, Cratere Astroni, 31.5.2023, male terminalia; (20) *Sarcophaga (Heteronychia) siciliana* ENDERLEIN, 1928, Monte Barbaro, 30.5.2023, phallus lateral; (21) *Sarcophaga (Heteronychia) siciliana* ENDERLEIN, 1928, Monte Barbaro, 30.5.2023, distiphallus dorsal.



**Figs 22-27:** (22) *Sarcophaga (Heteronychia) siciliana* ENDERLEIN, 1928, Monte Barbaro, 30.5.2023, male terminalia; (23) *Sarcophaga (Heteronychia) tetrax* WHITMORE, 2011, Monte Nuovo, 12.4.2023, male terminalia; (24) *Sarcophaga (Liopygia) argyrostoma* (ROBINEAU-DESVOIDY, 1830), Monte Nuovo, 29.5.2023, male terminalia; (25) *Sarcophaga (Liopygia) crassipalpis* MACQUART, 1839, Monte Barbaro, 29.4.2023, male terminalia; (26) *Sarcophaga (Heteronychia) tetrax* WHITMORE, 2011, Monte Nuovo, 12.4.2023, male terminalia; (27) *Sarcophaga (Heteronychia) tetrax* WHITMORE, 2011, Monte Nuovo, 12.4.2023, distiphallus, semi-lateral.



**Figs 28-33:** (28) *Sarcophaga (Liosarcophaga) dux* THOMSON, 1869, Monte Nuovo, 29.5.2023, male terminalia; (29) *Sarcophaga (Liosarcophaga) dux* THOMSON, 1869, Monte Nuovo, 29.5.2023, male terminalia; (30) *Sarcophaga (Liosarcophaga) portschinskyi* (ROHDENDORF, 1937), Monte Nuovo, 17.4.2023, male terminalia; (31) *Sarcophaga (Liosarcophaga) portschinskyi* (ROHDENDORF, 1937), Monte Nuovo, 17.4.2023, pregonite of male genitalia; (32) *Sarcophaga (Liosarcophaga) teretirostris* PANDELLÉ, 1896, Monte Barbaro, 30.5.2023, male terminalia; (33) *Sarcophaga (Liosarcophaga) tibialis* MACQUART, 1851, Monte Nuova, 29.5.2023, male terminalia.



**Figs 34-35:** (34) *Sarcophaga (Sarcophaga) croatica* BARANOV, 1941, Monte Nuovo, 27.4.2023, male terminalia; (35) *Sarcophaga (Sarcophaga) croatica* BARANOV, 1941, Monte Nuovo, 27.4.2023, juxta of distiphallus.

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