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Composition, Abundance and Richness of Sarcophagidae (Diptera: Oestroidea) in Forests and Forest Gaps with Different Vegetation Cover

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Abstract

This study was carried out in the Base Operacional Geólogo Pedro de Moura (BOGPM) in the Urucu River Basin, Coari, state of Amazonas, Brazil, during April, June, and October 2007, in 16 areas, 4 in primary forests (environment MT) and 12 in gaps (environments C1, C2, and C3) at different stages of vegetation recovery, with different plant cover height. We collected 3,547 specimens of flesh flies. The 3,525 individuals identified to species level included 10 genera, 6 subgenera, and 23 species. *Sarcodexia lambens* (Wiedemann) (47.1%) and *Peckia* (*Peckia*) *chrysostoma* (Wiedemann) (19.1%) were the most abundant species. The abundance patterns and estimated richness differed between the environments, and were separated in two groups, one of the gaps (C1, C2, and C3) and another of forests (MT). Both abundance and estimated richness were higher in the gaps (C1, C2, and C3) than in the forest (MT).

Introduction

Flies of the family Sarcophagidae are very common and very similar to certain blowflies (Calliphoridae) in their appearance and habits. Most feed on decomposing organic matter, and some are invertebrate and vertebrate parasites (Guimarães & Papavero 1999). This family comprises about 2,600 described species worldwide, with about 800 species recorded in the Neotropics, 298 of them in Brazil (Pape 1996). They are found in all biogeographical regions, however most occur in tropical and warm-temperate regions (Shewell 1987).

Knowledge on the Amazon flesh flies is fragmentary, and the latest catalog of world species indicated fewer than 60 records for the Brazilian Amazon region (Pape 1996). Studies in specific locations of the Amazon include those of Lopes & Tibana (1991) on Maracá Island in the state of Roraima; Couri *et al* (2000) in Serra do Navio, state of Amapá; and Esposito & Linhares (2002), in Floresta Nacional Caxiuanã, state of Pará.

The family Sarcophagidae shows different degrees of synanthropy, with some species that live only in natural environments and others that are adapted to live in the human environment, and some species even depend on this kind of enviroment (Linhares 1981, Dias *et al* 1984a, D'Almeida 1984). This situation and the rapid population responses suggest the possibility that patterns of abundance and richness of Sarcophagidae could be used as indicators of anthropic interference on natural environments.

The Urucu River Basin region, in the Municipality of Coari, contains vast areas of preserved forest, but also forest gaps opened for prospection of oil and natural gas by Petrobrás S.A. Therefore, the region offers a rare opportunity to carry out studies on the effect of vegetation cover on the fauna. The fauna of blowflies in this area was studied by Paraluppi (1996) and Sousa *et al* (2010). The present study is the first on the fauna of Sarcophagidae in the region.

We studied the composition, abundance, and richness of the flesh fly fauna in the Urucu region, and compared the richness and abundance in environments with different vegetation cover. It was expected that the richness and abundance values for the family and species of Sarcophagidae would be different in the four environments sampled in the present study.

Material and Methods

This study is part of the research network "Evaluation of the bio-ecological dynamics and recomposition of areas altered by oil prospecting", in the area of Urucu, Amazonas, funded by the FINEP/CTPETRO project "Dynamics of forest gaps impacted by oil exploration." It was carried out in the oil exploration area of PETROBRÁS S.A., Base Operacional Geólogo Pedro de Moura (BOGPM) located in the region of the Urucu River Basin, Coari, Amazonas. The area is 600 km west of the city of Manaus, between 4º51'18" and 4º52'16" S and 65º17'58" and 65º20'01" W, altitude between 60 m and 70 m, and is 514,000 ha in extent (Fig 1).

Sixteen study areas were selected, at least 1 km distant from each other (Fig 1). Four of them were in primary forest, and 12 in gaps at different stages of vegetation recovery and differing in their plant cover height, according to Pillar (1996). The four types of environments were: 1) MT, areas of preserved forests; 2) C1, gaps with little recovery, herbaceous vegetation of varying heights from 30 cm to 50 cm; 3) C2, gaps in an intermediate stage of recovery, shrubby vegetation I, height from 50 cm to 2 m; and 4) C3, well recovered gaps, shrubby vegetation II, between 2 m and 5 m in height. The environments were considered as sampling units, and in each environment three collections were made in order to obtain a more representative effort. These three collections were made in April, June, and October 2007.

We utilized flytraps as described by Almeida *et al* (2003), baited with 50 g of rotting beef lung. The traps were exposed for 48h in the field. We used four traps in each environment, totaling 16 traps per environment, 64 traps per collection, and 192 traps at the end of three collections.

The traps were placed in the center of the gap areas from the north-south and east-west positions, not more than 50 m apart. In the forest areas, the traps were placed in a similar way, but at 300 m from the forest edge.

Flesh-fly identification was based on Lopes (1939, 1946, 1958, 1976, 1989), Lopes & Tibana (1982, 1987), and Pape & Mello-Patiu (2006). Part of the material was deposited at the Entomological Collection of the Museu Paraense Emílio Goeldi (MPEG), Belém, Pará.

In order to assess if the sampling effort was sufficient to sample all available species in this locality, we utilized the following richness estimators: Chao 1, Chao 2, Jack2 (second-order Jackknife), ICE (Incidence-based Coverage Estimator), ACE (Abundance-based Coverage Estimator), and Bootstrap, by using the Estimate S 8.0 software (Colwell 2006a). The non-parametric estimators for species richness that are based on rare species richness use four variables: singletons, doubletons, uniques, and duplicates (Colwell 2006b). These methods of analysis

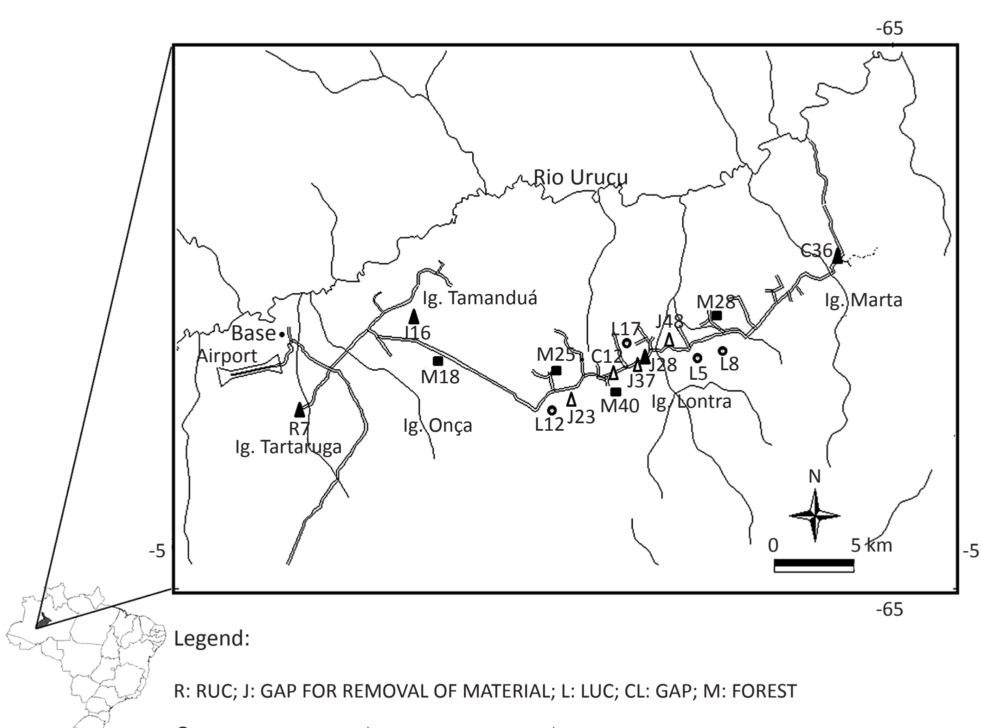

Fig1 Map showing the 16 areas studied in the Base Operacional Geólogo Pedro de Moura (BOGPM), Urucu River Basin, Coari, Amazonas.

were used because they analyze data with different abundance distributions (Santos 2006).

In order to compare species richness in the 16 environments, we used the rarefaction method based on the number of individuals by specimen, using the BioDiversity Pro 2.0 software (McAleece *et al* 1997). This relationship of richness to abundance (rarefaction curve) (Magurran 2004) was calculated in order to determine differences between the areas, using a cutoff score equivalent to the lowest abundance found in the areas (18 individuals in the M28 area). According to Ricklefs (1996) and Magurran (2004), this analysis is appropriate when the samples include different numbers of individuals, as in this case; in this way, subsamples of equal size of individuals are taken randomly, and thus an estimate of the richness is obtained that makes the samples comparable to each other.

The four kinds of environment were compared with respect to the estimated richness and abundance pattern for the family and for the more numerous species, with the one-criterion variance analysis (Ayres *et al* 2007). The abundance of species was processed through the function log n (x + 1) to decrease the influence of numerical range of taxa more abundant. The normality of the data was checked by the Lilliefors test (k samples) (Ayres *et al* 2007). These analysis were carried out using the BioEstat 5.0 statistical software (Ayres *et al* 2007), and the results were considered significant when P < 0.05.

Results

Composition and abundance

A total of 3,547 flesh flies were collected, and 3,525 individuals were identified to species level. These represented 10 genera, six subgenera, and 23 species (Table 1). The most abundant species were *Sarcodexia lambens* (Wiedemann) with 47.1% of the total individuals, followed by *Peckia* (*Peckia*) *chrysostoma* (Wiedemann) with 19.1% (Table 1).

Table 1 Composition and abundance of flesh fly species in the Base Operacional Geólogo Pedro de Moura (BOGPM), Urucu River Basin, Coari, Amazonas.

Species	Total	%
Engelimyia inops (Walker)	1	0.02
Helicobia pilífera Lopes	37	1.04
Nephochaetopterix spp.	3	0.08
Oxysarcodexia amorosa (Schiner)	151	4.25
Oxysarcodexia angrensis (Lopes)	1	0.02
Oxysarcodexia fringidea(Curran & Walley)	155	4.36
Oxysarcodexia major Lopes	1	0.02
Oxysarcodexia spp.	6	0.16
Oxysarcodexia thornax (Walker)	164	4.62
Peckia (*Euboettcheria*) *alvarengai* (Lopes & Tibana)	3	0.08
Peckia (*Euboettcheria*) *anguilla* (Curran & Walley)	6	0.16
Peckia (*Euboettcheria*) *collusor* (Curran & Walley)	69	1.94
Peckia (*Euboettcheria*) *epimelia* (Lopes)	1	0.02
Peckia (*Euboettcheria*) spp.	10	0.28
Peckia (*Pattonella*) *intermutans* (Walker)	106	2.98
Peckia (*Pattonella*) *pallidipilosa* (Curran & Walley)	4	0.11
Peckia (*Pattonella*) *smarti* (Lopes)	1	0.02
Peckia (*Peckia*) *chrysostoma* (Wiedemann)	678	19.11
Peckia (*Peckia*) *pexata* (Wulp)	2	0.05
Peckia (*Peckia*) spp.	1	0.02
Peckia (*Squamatodes*) *ingens* (Walker)	242	6.82
Peckiamyia abnormalis (Hall)	1	0.02
Peckiamyia minutipenis (Hall)	1	0.02
Peckiamyia spp.	2	0.05
Sarcodexia lambens (Wiedemann)	1,669	47.05
Sarcofahrtiopsis cuneata Townsend	229	6.45
Titanogripa (*Cucullomyia*) *luculenta* (Lopes)	1	0.02
Trichaeae (*Sarcophagula*) *occidua* (Fabricius)	2	0.05
Total	3,547	100

Richness

The analysis of species incidence and abundance patterns for the total samples, with observed richness of 23 species and abundance of 3,525 individuals, estimated a minimum of 26 (Bootstrap) and a maximum of 59 species (ICE) (Fig 2). The number of rare species ranged between one and 10, distributed as follows: two doubletons, one duplicate, eight singletons, and 10 uniques (Fig 3).

Comparison between richness and abundance of flesh flies in the different environments

The order of richness observed ranged from three species, in area M25 (MT) to 13, in areas J23 (C2) and R7 (C3). The estimation of richness of species of flesh flies for each area by the rarefaction method indicated the following order of richness: a minimum of three in M25 (MT) for a total of 18 individuals collected and seven in J16 (C3), for the highest estimate with the same number of individuals collected. The forests showed the lowest species richness per individual, with an estimated species number less than five (Fig 4).

The rarefaction analysis indicated the formation of two groups, one formed by four areas of forest (environment MT), with lower richness, and the other by areas of forest

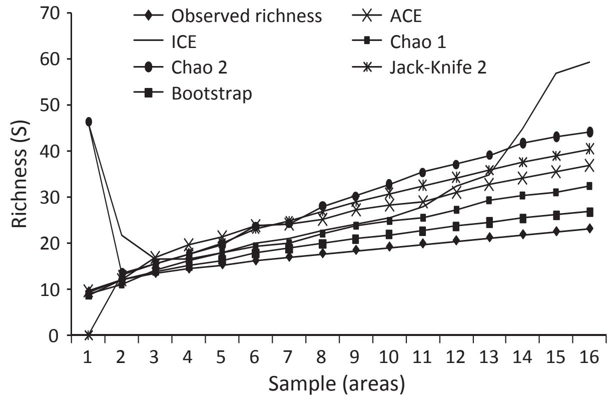

Fig 2 Comparison between estimated and observed richness (Chao 1, Chao 2, Jackknife 2, ICE, ACE, and Bootstrap), for the Sarcophagidae community in the Base Operacional Geólogo Pedro de Moura (BOGPM), Urucu River Basin, Coari, Amazonas.

gaps (environments C1, C2, and C3), with higher richness (Fig 4).

The estimated richness of flesh flies for the different environments was different as calculated by the rarefaction method (F = 11.6015, DF = 3, P = 0.001). The multiple comparison test showed a significant difference between (C1 – MT), (C2 – MT) and (C3 – MT) (Table 2).

The abundance values for the 16 sampled areas are available as *Online Supplementary Material*. The abundance differed among the environments (F = 36.5156, DF = 3, P < 0.0001) (Table 3). The comparison among environments indicated significant differences among the pairs (C1 – MT), (C2 – MT) and (C3 – MT) (Table 3). The comparison among the environments (C1 – C2), (C1 – C3), and (C2 – C3) was not significant (Table 3).

The abundance of the eight most numerous species also differed among the environments (Table 4). The comparison of environments showed differences

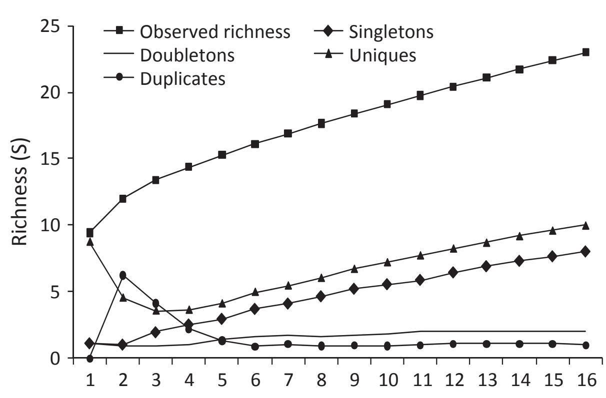

Fig 3 Estimated and observed richness of rare species for the Sarcophagidae community in the Base Operacional Geólogo Pedro de Moura (BOGPM), Urucu River Basin, Coari, Amazonas.

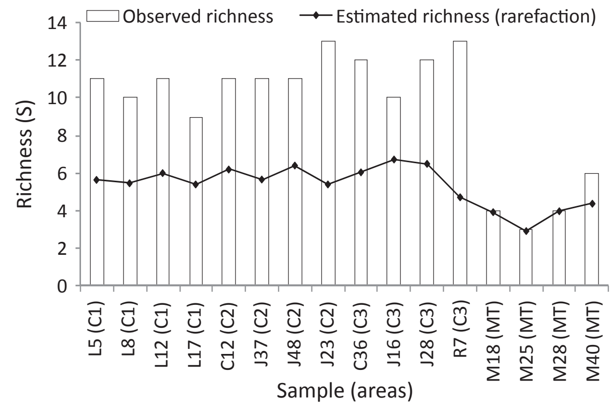

Fig 4 Observed richness of flesh fly species (columns) and estimated richness according to rarefaction method (lines) in each of the 16 areas sampled in the Base Operacional Geólogo Pedro de Moura (BOGPM), Urucu River Basin, Coari, Amazonas. The base value used for comparison between the areas was 18 individuals in the rarefaction calculations.

Table 2 Results from one-criterion variance analysis test and a posteriori multiple comparison test (Tukey) for estimated richness of flesh flies between the environments sampled in the Oil Extraction Base, Urucu River Basin, Coari, Amazonas. The values in bold indicate significant differences for α < 0.05.

H	Degrees of freedom	(P) Anova	Comparison (Tukey)	P
11.6015	3	0.001	C1 - C2	ns
			C1 - C3	ns
			C1 - MT	< 0.01
			C2 - C3	ns
			C2 - MT	< 0.01
			C3 - MT	< 0.01

Table 3 Results from one-criterion variance analysis tests and a posteriori multiple comparison tests (Tukey) for abundance of flesh flies between the environments sampled in the Base Operacional Geólogo Pedro de Moura (BOGPM), Urucu River Basin, Coari, Amazonas. The values in bold indicate significant result for α < 0.05.

H	Degrees of freedom	(P) Anova	Comparison (Tukey)	P
36.5156	3	< 0.0001	C1 - C2	ns
			C1 - C3	ns
			C1 - MT	< 0.01
			C2 - C3	ns
			C2 - MT	< 0.01
			C3 - MT	< 0.01

between the pairs: (C1 – MT), (C2 – MT) and (C3 – MT) for the species *Oxysarcodexia amorosa* (Schiner), *Oxysarcodexia fringidea* (Curran & Walley), *Peckia* (*Pattonella*) *intermutans* (Walker), *P*. (*P*.) *chrysostoma, Peckia* (*Squamatodes*) *ingens* (Walker), *S. lambens,* and *Sa*. *cuneata* (Table 4); and between the pairs: (C1 – MT); (C2 – MT), (C3 – MT) and (C2 – C3), for *Oxysarcodexia thornax* (Walker) (Table 4).

Discussion

Composition and abundance

The species *Peckia* (*Euboettcheria*) *epimelia* (Lopes) and *Sarcofahrtiopsis cuneata* Townsend are new records for the Brazilian Amazon. The former species had been recorded only for the state of São Paulo, and the latter for the states of Ceará, Pernambuco, and Rio de Janeiro (Pape 1996). *Helicobia pilifera* Lopes and *Titanogripa* (*Cucullomyia*) *luculenta* Lopes are new records for the state of Amazonas. *Helicobia pilifera* was previously recorded in Pará (Tibana 1981), and *T*. (*C*.) *luculenta* in Amapá (Lopes 1976). Couri *et al* (2000) reported *S. lambens* from the Serra do Navio, Amapá; and Esposito & Linhares (2002) reported *P*. (*P*.) *chrysostoma* in the Floresta Nacional Caxiuanã, Melgaço, PA, where both species were also the most abundant ones.

Richness

The curve of doubletons and duplicate species showed that they had stabilized. However, the curves of singletons and uniques showed moderate growth, without stabilizing. According to the classification parameters of Toti *et al* (2000), the estimates for this family did not show good performance, suggesting that the sampling effort was not sufficient to show the richness of the area.

Table 4 Results from one-criterion variance analysis test and a posteriori multiple comparison test (Tukey) results for abundance of the dominant flesh fly species between the environments sampled in the Base Operacional Geólogo Pedro de Moura (BOGPM), Urucu River Basin, Coari, Amazonas. The values in bold indicate a significant result for α < 0.05.

Species	F	Degrees of freedom	(P) Anova	Comparison (Tukey)	P	Comparison (Tukey)	P
O. amorosa	45.0054	3	< 0.0001	C1 - C2	ns	C2 - C3	ns
				C1 - C3	ns	C2 - MT	< 0.01
				C1 - MT	< 0.01	C3 - MT	< 0.01
O. fringiidae	36.1738	3	< 0.0001	C1 - C2	ns	C2 - C3	ns
				C1 - C3	ns	C2 - MT	< 0.01
				C1 - MT	< 0.01	C3 - MT	< 0.01
O. thornax	41.6359	3	< 0.0001	C1 - C2	ns	C2 - C3	< 0.05
				C1 - C3	ns	C2 - MT	< 0.01
				C1 - MT	< 0.01	C3 - MT	< 0.01
P. (*Pa.*) *intermutans*	9.8811	3	0.0018	C1 - C2	ns	C2 - C3	ns
				C1 - C3	ns	C2 - MT	< 0.01
				C1 - MT	< 0.01	C3 - MT	< 0.01
P. (*P.*) *chrysostoma*	25.3393	3	< 0.0001	C1 - C2	ns	C2 - C3	ns
				C1 - C3	ns	C2 – MT	< 0.01
				C1 - MT	< 0.01	C3 - MT	< 0.01
P. (*S.*) *ingens*	29.9432	3	< 0.0001	C1 - C2	ns	C2 - C3	ns
				C1 - C3	ns	C2 – MT	< 0.01
				C1 - MT	< 0.01	C3 - MT	< 0.01
S. lambens	43.8224	3	< 0.0001	C1 - C2	ns	C2 - C3	ns
				C1 - C3	ns	C2 - MT	< 0.01
				C1 - MT	< 0.01	C3 - MT	< 0.01
Sa. cuneata	9.999	3	0.0017	C1 - C2	ns	C2 - C3	ns
				C1 - C3	ns	C2 - MT	< 0.01
				C1 - MT	< 0.01	C3 - MT	< 0.01

The family Sarcophagidae is very diverse in the Neotropical region, with over 750 described species, over 298 of them recorded from Brazil (Pape 1996). Because of the large number of species and the variety of their habitats, an additional sampling effort is necessary in order to obtain the total species richness in this locality.

Comparison between richness and abundance of flesh flies in the different environments

Although the gaps did not show differences between the abundance and estimated richness patterns, they were different from the forests. The flesh flies did not show sensitivity in relation to types of gaps, as was recorded for blow flies by Sousa *et al* (2010); but did show differences between gaps and forests.

Ferraz *et al* (2009) recorded a lower richness of blowflies species at locations near to the entrance (greater anthropic impact) of the Reserva Biológica de Tinguá, Nova Iguaçu, Rio de Janeiro. Sousa *et al* (2010) found a lower richness of blowflies species in gaps in the Urucu River Basin, Coari, Amazonas.

The occurrence of more species of flesh flies in gap environments may be related to the physical conditions and to the variety of available resources in these environments. The resources in open environments are more exposed to rain and dryness, which makes them more ephemeral. Because the Sarcophagidae are viviparous or ovoviviparous (Shewell 1987), their larvae remain for shorter periods in the substrates where they breed, and they are therefore less exposed to the environmental conditions in the forest gaps. This characteristic may confer an advantage to the Sarcophagidae in exploiting resources in open areas.

The family Sarcophagidae was more abundant in gap environments than in the forests. This may be related to the ample capacity of adaptation to the human-modified environments shown by flesh flies, even becoming dependent on them. The eusynanthropic characteristic of some species of this family has been already recorded (Linhares 1981, Dias *et al* 1984a, D'Almeida 1984).

In a study in three distinct ecological areas (urban, rural, and forest) in Belo Horizonte, Minas Gerais, Dias *et al* (1984b) reported that the flesh flies were attracted most by decomposing organic matter, and human feces was the most attractive bait. Antonini *et al* (2005) found that flesh flies were more abundant in marginal sites of a forest fragment than inside it, in Belo Horizonte.

Peckia (*Pa*.) *intermutans* was the most abundant species in the forests (Table 5). According to Linhares (1981) and D'Almeida & Lopes (1983), this is a hemisynanthropic and necrophagous species, which develops in animal carcasses.

The other common species were more abundant in forest gap areas (C1, C2, and C3) (Table 5). Of these species, *S. lambens* and *P.* (*P.*) *chrysostoma* were considered eusynanthropic by D'Almeida (1984) and Ferraz (1995). *Peckia* (*P.*) *chrysostoma* was more abundant in environments closer to residences than in forested environments at two sites in the Floresta Nacional Caxiuanã, (Base of the Estação Científica Ferreira Pena and Boca do Curuá).

The abundance pattern and estimated richness of flesh flies were not able to separate the gap environments, but did separate gaps from forests. The association with human-impacted environments suggests that this taxon

Table 5 Composition and abundance of flesh fly species collected from the 4 types of environment of the Base Operacional Geólogo Pedro de Moura (BOGPM), Urucu River Basin, Coari, Amazonas.

Species	C1	C2	C3	MT	Total
Engelimyia inops	0	0	1	0	1
Helicobia pilífera	15	13	9	0	37
Nephochaetopterix spp.	1	1	0	1	3
Oxysarcodexia amorosa	43	69	39	0	151
Oxysarcodexia angrensis	0	1	0	0	1
Oxysarcodexia fringidea	46	72	37	0	155
Oxysarcodexia major	0	0	1	0	1
Oxysarcodexia spp.	5	1	0	0	6
Oxysarcodexia thornax	56	78	30	0	164
Peckia (*E.*) *alvarengai*	0	2	1	0	3
Peckia (*E.*) *anguilla*	1	3	1	1	6
Peckia (E.) *collusor*	14	35	15	5	69
Peckia (*E.*) *epimelia*	0	1	0	0	1
Peckia (*E.*) spp.	3	6	0	1	10
Peckia (*Pa.*) *intermutans*	7	15	18	66	106
Peckia (*Pa.*) *pallidipilosa*	0	0	2	2	4
Peckia (*Pa.*) *smarti*	0	0	0	1	1
Peckia (*P.*) *chrysostoma*	236	232	198	12	678
Peckia (*P.*) *pexata*	0	2	0	0	2
Peckia (*P.*) spp.	1	0	0	0	1
Peckia (*S.*) *ingens*	63	89	90	0	242
Peckiamyia abnormalis	0	0	1	0	1
Peckiamyia minutipenis	0	0	1	0	1
Peckiamyia spp.	1	1	0	0	2
Sarcodexia lambens	444	776	442	7	1,669
Sarcofahrtiopsis cuneata	65	105	59	0	229
Titanogripa (*C.*) *luculenta*	1	0	0	0	1
Trichaeae (*S.*) *occidua*	2	0	0	0	2
Total	1,004	1,502	945	96	3,547

may be appropriate to evaluate anthropic impacts such as deforestation.

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Online Supplementary Material

Sousa JRP, Esposito MC, Carvalho Filho MC (2011) Composition, Abundance and Richness of Sarcophagidae (Diptera: Oestroidea) in Forests and Forest Gaps with Different Vegetation Cover

Composition and absolute and relative abundance of collected flesh flies in the 16 areas of the Base Operacional Geólogo Pedro de Moura (BOGPM), Urucu River Basin, Coari, Amazonas. Environments C1 (L5,L8,L12,L17), C2 (C12,J37,J48,J23), C3 (C36,J16,J28,R7), MT (M18,M25,M28,M40).

Species	L5	L8	L12	L17	C12	J37	J48	J23	C36	J16	J28	R7	M18	M25	M28	M40	Total
E. inops	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
H. pilífera	6	6	3	0	7	2	1	3	2	5	0	2	0	0	0	0	37
Nephochaetopterix spp.	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	3
O. amorosa	20	8	8	7	19	20	17	13	19	7	7	6	0	0	0	0	151
O. angrensis	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
O. fringiidae	15	17	7	7	17	23	14	18	20	7	5	5	0	0	0	0	155
O. major	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Oxysarcodexia spp.	0	4	1	0	0	1	0	0	0	0	0	0	0	0	0	0	6
O. thornax	26	11	11	8	26	15	13	24	13	5	4	8	0	0	0	0	164
P. (*E.*) *alvarengai*	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	3
P. (*E.*) *anguila*	0	0	1	0	1	0	2	0	0	0	1	0	0	0	0	1	6
P. (*E.*) *collusor*	5	1	4	4	9	8	5	13	4	1	4	6	0	1	2	2	69
P. (*E.*) *epimelia*	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Peckia (*E.*) spp.	1	0	0	2	2	2	2	0	0	0	0	0	0	0	1	0	10
P. (*Pa.*) *intermutans*	1	0	2	4	2	7	3	3	2	5	7	4	12	16	13	25	106
P. (*Pa.*) *palidipilosa*	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	4
P. (*Pa.*) *smarti*	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
P. (*P.*) *chrysostoma*	77	36	81	42	41	70	32	89	55	45	31	67	3	0	2	7	678
P. (*P.*) *pexata*	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2
Peckia (*P.*) spp.	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
P. (*S.*) *ingens*	11	3	21	28	14	18	31	26	25	19	19	27	0	0	0	0	242
Pe. abnormalis	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Pe. minutipenis	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Peckiamyia spp.	0	0	1	0	0	0	1		0	0	0	0	0	0	0	0	2

Continue

Species	L5	L8	L12	L17	C12	J37	J48	J23	C36	J16	J28	R7	M18	M25	M28	M40	Total
S. lambens	194	103	59	88	162	196	103	315	145	29	42	226	3	2	1	1	1,669
Sa. cuneata	36	9	17	3	19	13	15	58	30	13	2	14	0	0	0	0	229
T. (*C.*) *luculenta*	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Tr. (*S.*) *occidua*	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Total	394	200	216	194	319	377	239	567	317	136	124	368	20	19	19	38	3,547
Relative abundance (%)	11.10	5.64	6.09	5.47	8.99	10.63	6.73	15.99	8.93	3.83	3.50	10.37	0.57	0.54	0.54	1.08	100