Ecology of Mosquitoes (Diptera: Culicidae) in Areas of Serra do Mar State Park, State of São Paulo, Brazil. II - Habitat Distribution

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The mosquito (Diptera: Culicidae) ecology was studied in areas of Serra do Mar State Park, State of São Paulo, Brazil. Systematized biweekly human bait collections were made three times a day, for periods of 2 or 3 h each, in sylvatic and rural areas for 24 consecutive months (January 1991 to December 1992). A total of 24,943 adult mosquitoes belonging to 57 species were collected during 622 collective periods.

Aedes scapularis, Coquillettidia chrysonotum, Cq. venezuelensis, Wyeomyia dyari, Wy. longirostris, Wy. theobaldi *and* Wy. palmata *were more frequently collected at swampy and at flooded areas.* Anopheles mediopunctatus, Culex nigripalpus, Ae. serratus, Ae. fulvus, Psorophora ferox, Ps. albipes *and the Sabethini in general, were captured almost exclusively in forested areas.* An. cruzii, An. oswaldoi *and* An. fluminensis *were captured more frequently in a residence area. However,* Cx. quinquefasciatus *was the only one truly eusynanthropic.*

An. cruzii *and* Ae. scapularis *were captured feeding on blood inside and around the residence, indicating that both species, malaria and arbovirus vectors respectively, may be involved in the transmission of these such diseases in rural areas.*

Key words: mosquitoes - ecology - vectors - Serra do Mar - Brazil

The ecology of mosquitoes that are potential vectors of human and/or animal pathogens in areas of the Serra do Mar State Park - PESM, Picinguaba Nucleus, City of Ubatuba, State of São Paulo, is poorly understood (Figs 1a, 2a). The seasonal distribution of mosquitoes is described in the prior work. This study describes seasonal abundance related to four types of habitat associated with the park.

MATERIALS AND METHODS

Four collections sites were selected (A/B/C/D) in sylvatic and rural environments in PESM. Samples were taken biweekly in human bait during different periods of the day, for 24 consecutive months (January 1991 to December 1992). Descriptions of collection sites are as follows:

Site A: located along the margins of the Fazenda River in the swampy area of the sandy lands through along the 3,500 m of Fazenda Beach, which is the only sea level point of the park. Aquatic vegetation partially covers the swamp and so influence the local mosquito fauna (Fig. 1b).

Site B: outside the beach zone, approximately 1,500 m from the sea. It typically consists of shrub vegetation cover and is frequently subjected to floods during the rainy season, creating small swampy habitats. The soil is sandy with leaf material in edaphication process (Fig. 1c).

Site C: this is the most representative of the region's primitive forest, not only because of taller vegetation with orchids and bromeliads, but also for its humidity and temperature levels (Fig. 2b).

Site D: this site, a clearing in a forested area, was chosen as a representative site of existing human activity in the interior of the park. One of the residences was selected to evaluate Culicidae cohabitation (Fig. 2c).

Biweekly collections in sites A, B and C were conducted in three periods each day: daylight (10:00-12:00 h and 14:00-16:00 h) and nocturnal (18:00-21:00 h). In each sampling period two team members collected mosquitoes by mouth aspirators using themselves as attractant.

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Human-bait collection was also conducted in site D biweekly and simultaneously in three different situations: inside the house, catching not only specimens attracted by man but also those resting on the internal walls; outside the house, catching mosquitoes attracted by human-bait and also those resting on the external walls of the house; and around the house, collecting specimens attracted by human-bait at the margins of the forest that surrounds the house, in distances never more than 50 m. However, collections were only conducted from 18:00-21:00 h.

Collected mosquitoes were killed by chloroform and arranged in labeled small boxes. Mosquitoes were returned to the laboratory where they were identified according to classic literature and systematic proposals of Harbach and Kitching (1998) and Judd (1996, 1998) for the Sabethini tribe. Specimens were incorporated in the Entomological Collection, Entomology Department, Instituto Oswaldo Cruz, under the title of "Atlantic Forest Collection".

Mosquito species site preferences were determined by using Williams averages (X_w) according to the definitions of Haddow (1954, 1960) and Forattini et al. (1981).

Statistical analysis and graphical representation were not made for all species. To evaluate the preference of the species for a certain type of habitat, there were considered only the species collected with a total number of individuals greater than 1% of its subfamily or tribe total number of collected specimens in at least one of the exclusively sylvatic environment, sites A, B and C. To evaluate the species behavior toward the rural residence (site D), were selected for the analysis only the species with a total number of collected individuals greater than 1% of the total collected specimens in site D.

RESULTS

Preferences for sampling sites - Two aspects were especially evident: the great diversity of Culicidae species present and the clear preference of some of them for certain habitats. This distribution was directly associated to the characteristics of the 47.000 ha of Picinguaba Nucleus of PESM. Four different biotopes were characterized in the previously described collection sites (Figs 1b, c, 2b, c).

This habitat association is clearly seen in the swampy areas of site A and in the flooded areas of site B, where *Coquillettidia chrysonotum* predominates. In sites B and C, both in typical Atlantic Forest areas, the greatest species diversity was observed, with Sabethini tribe members occurring primarily in these areas (Table I).

Site D was located in one of the residences inside PESM, and was characterized by the inclusion of synanthropic species. Among them, *Culex quinquefasciatus* stands out, as it was found exclusively at that site (Fig. 3). Species such as *Anopheles cruzii*, *Aedes scapularis*, *Cq. chrysonotum* and *Cq. venezuelensis* were also present in these samplings.

In the Anophelinae species studied *An. fluminensis* preferred site D the most, followed by *An. cruzii* and *An. oswaldoi*. For the sylvatic environment, these three species preferred first site B, characterized by shrub-like vegetation, then site C, with taller vegetation, and then site A, the swampy area nearby the beach. *An. mediopunctatus* preferred the low scrub with temporary forest pools of site B.

Cx. quinquefasciatus was present exclusively in site D. *Cx. nigripalpus* was captured in forested environments: sites B and C (Table I, Fig. 3).

The *Coquillettidia* affinity with site A is associated with the offer of specific breeding sites to support the development of immature forms. This is evident with Williams' mean analyses for the two species found at PESM. For both *Cq. chrysonotum* and *Cq. venezuelensis* we verified the greatest preference for site A, followed by site D, B and C, in this order (Table I, Fig. 3).

Psorophora ferox and *Ps. albipes* were rarely observed in site D and concentrated their greatest incidences was concentrated in the denser forest site samplings (Table I, Fig. 3).

Members of Sabethini tribe, generally considered sylvatic mosquitoes, were rarely present in the site D collections (Fig. 3). Among Sabethini species at this site, *Runchomyia reversa* was the one that occurred most frequently. *Ru. frontosa* was captured exclusively in the sylvatic environments of sites C, B and A, respectively (Table I, Fig. 3).

The two species of *Trichoprosopon* captured, *Tr. digitatum* and *Tr. pallidiventer*, clearly preferred site C. *Tr. digitatum* presented few specimens in site D and B, $X_w = 0.1$ and $X_w = 0.5$, against $X_w = 4.2$ in site C. *Tr. pallidiventer* occurred only in site B and in site C, preferring this last one (Table I, Fig. 3).

The *Wyeomyia* occurred exclusively in the sylvatic environment, except for rare specimens of *Wy. mystes* and *Wy. dyari* collected at the forest domicile in site D. Although they both occurred at the residence, these two species presented different preferences for sylvatic environments. *Wy. dyari* was the only species in the genus to show a significant tendency for site A, with $X_w = 12.4$ verses $X_w = 9.6$ in site B, $X_w = 7.2$ in site C and $X_w = 0.2$ in site D. *Wy. mystes* first preferred site B, with $X_w = 18.8$, than $X_w = 13.9$ for site C, $X_w = 1.0$ for site A and $X_w = 0.1$ for site D. Of other three studied species, *Wy. confusa*, *Wy. aporonoma* and specially

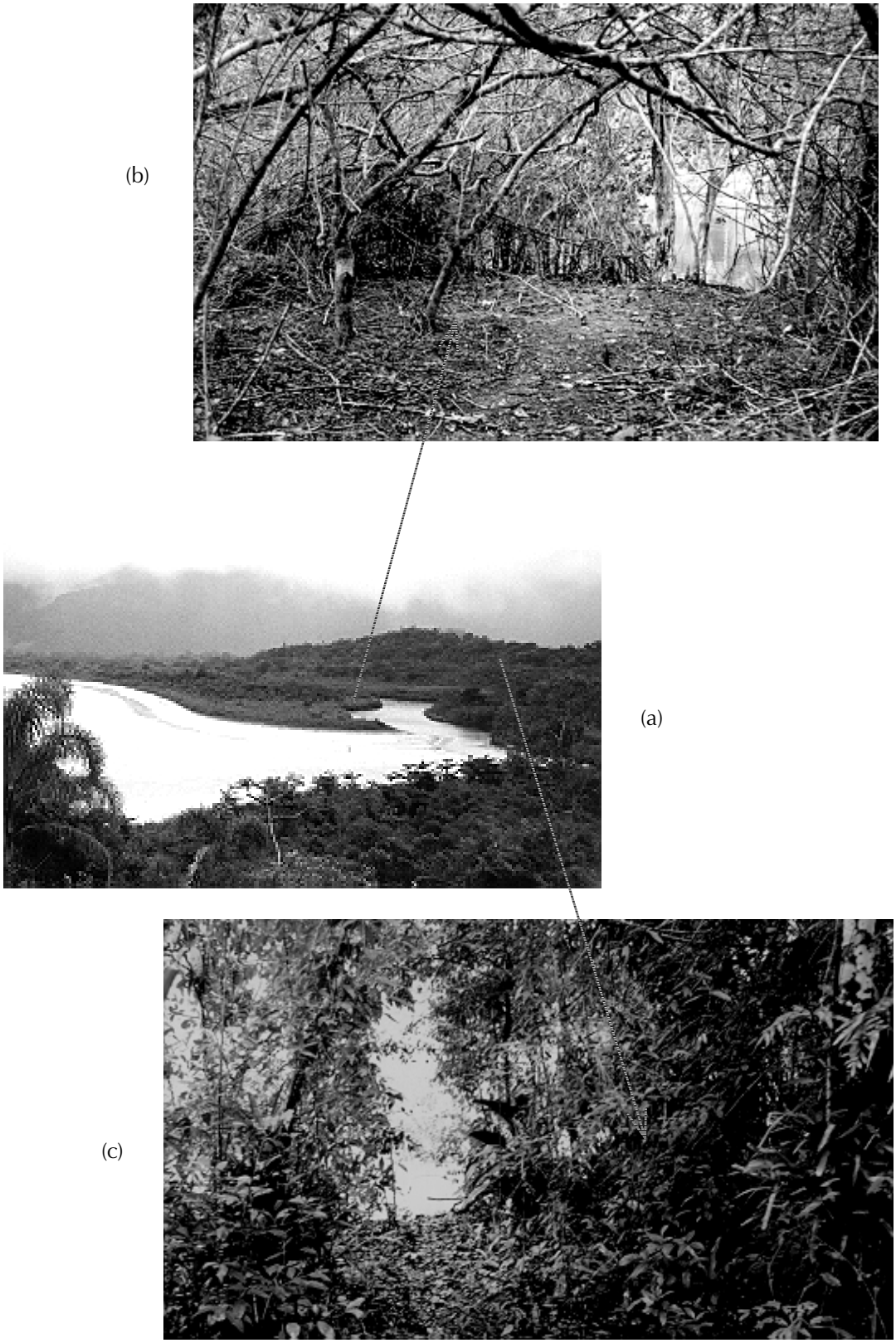

Fig. 1 - a: general view of the Picinguaba Nucleus of Serra do Mar State Park, State of São Paulo; b: highlighting Site A; c: Site B.

TABLE I

Number (N) and Willians averages (X_w) of Culicidae captured by sampling site, Picinguaba Nucleus of Serra do Mar State Park, State of São Paulo, January 1991 to December 1992

Species	Site A		Site B		Site C		Site D		Total
	N	X_W	N	X_W	N	X_W	N	X_W	N
ANOPHELINAE									
Anopheles cruzii	14	0.8	207	8.7	60	3.4	298	15.0	579
An. albitarsis s. l.	0	0.0	0	0.0	0	0.0	3	0.2	3
An. argyritarsis	2	0.1	0	0.0	0	0.0	4	0.2	6
An. oswaldoi	21	0.9	18	1.1	18	0.7	34	1.9	91
An. strodei	1	0.1	0	0.0	0	0.0	0	0.0	1
An. intermedius	3	0.1	1	0.1	2	0.1	8	0.4	14
An. fluminensis	6	0.2	108	3.1	36	1.1	215	11.8	365
An. mediopunctatus	27	1.5	216	8.2	116	5.9	0	0.0	359
Sub-total	74	4.5	550	31.1	232	14.0	562	33.2	1,418
CULICINAE (excluding Sabethini)									
Culex nigripalpus	0	0.0	183	7.2	103	5.2	0	0.0	286
Cx. quinquefasciatus	0	0.0	0	0.0	0	0.0	207	9.3	207
Orthopodomyia albicosta	0	0.0	1	0.1	0	0.0	0	0.0	1
Aedes serratus	147	10.1	561	42.1	890	65.9	105	5.9	1,703
Ae. scapularis	222	15.5	106	7.5	90	5.2	70	4.3	488
Ae. fluviatilis	0	0.0	0	0.0	15	0.3	1	0.1	16
Ae. fulvus	16	0.5	5	0.3	233	9.6	0	0.0	254
Ae. terrens	1	0.1	1	0.1	9	0.4	1	0.1	12
Coquillettidia chrysonotum	3,682	125.6	3,848	58.1	1,012	39.1	2,872	71.7	11,414
Cq. venezuelensis	502	24.7	379	13.0	230	10.3	501	22.0	1,612
Psorophora ferox	138	6.1	254	13.6	894	52.3	14	0.5	1,300
Ps. albipes	47	2.1	159	8.6	553	31.3	18	0.9	777
Haemagogus leucocelaenus	0	0.0	4	0.2	12	0.8	0	0.0	16
Ha. capricornii	0	0.0	3	0.2	0	0.0	0	0.0	3
Uranotaenia geometrica	0	0.0	0	0.0	2	0.1	1	0.1	3
Sub-total	4,755	215.2	5,504	257.5	4,043	294.9	3,790	145.8	18,092
SABETHINI									
Shannoniana fluviatilis	0	0.0	0	0.0	1	0.1	0	0.0	1
Trichoprosopon digitatum	0	0.0	11	0.5	64	4.2	1	0.1	76
Tr. pallidiventer	0	0.0	9	0.5	142	3.2	0	0.0	151
Tr. simile	0	0.0	1	0.1	5	0.3	0	0.0	6
Runchomyia lunata	0	0.0	6	0.3	1	0.1	0	0.0	7
Ru. reversa	14	0.8	26	1.4	45	2.3	6	0.4	91
Ru. theobaldi	26	0.3	7	0.4	5	0.2	0	0.0	38
Ru. frontosa	23	1.1	60	3.6	96	6.3	0	0.0	179
Ru. humboldti	1	0.1	1	0.1	4	0.1	0	0.0	6
Wyeomyia. dyari	259	12.4	172	9.6	119	7.2	3	0.2	553
Wy. confusa	9	0.5	63	2.1	62	3.5	0	0.0	134
Wy. mystes	18	1.0	268	18.8	246	13.9	2	0.1	534
Wy. aporonoma	20	1.1	107	7.5	431	27.3	0	0.0	558
Wy. personata	0	0.0	3	0.2	9	0.3	0	0.0	12
Wy. shannoni	4	0.1	3	0.2	102	5.4	0	0.0	109
Wy. oblita	0	0.0	1	0.1	0	0.0	0	0.0	1
Wy. theobaldi	190	5.7	16	0.8	40	1.2	0	0.0	246
Wy. flabelata	25	1.5	142	9.2	227	14.7	0	0.0	394
Wy. pilicauda	3	0.2	2	0.1	6	0.3	0	0.0	11
Wy. splendida	28	1.6	73	4.5	246	13.2	3	0.2	350
Wy. palmata	39	1.3	11	0.6	13	0.7	0	0.0	63
Wy. longirostris	160	8.5	71	4.9	94	4.3	0	0.0	325
Wy. quasilongirostris	18	0.9	95	4.8	60	3.6	5	0.2	178

cont.

Wy. davisi	18	1.0	31	1.5	22	1.2	0	0.0	71
Wy. bonnei	33	2.1	97	4.7	205	10.8	0	0.0	335
Wy. lassalli	0	0.0	0	0.0	56	0.6	0	0.0	56
Limatus flavisetosus	25	1.4	111	5.8	363	21.2	0	0.0	499
Li. durhami	40	2.5	26	1.4	64	3.0	0	0.0	130
Li. pseudomethisticus	17	1.0	55	3.0	218	13.9	0	0.0	290
Sabethes quasicyaneus	2	0.1	1	0.1	0	0.0	0	0.0	3
Sa. intermedius	0	0.0	1	0.1	0	0.0	0	0.0	1
Sa. identicus	0	0.0	3	0.2	16	0.4	0	0.0	19
Sa. fabricii	0	0.0	2	0.1	1	0.1	0	0.0	3
Sa. soperi	0	0.0	2	0.1	1	0.1	0	0.0	3
Sub-total	972	54.7	1,477	97.6	2,964	198.7	20	0.9	5,433
Total	5,801	310.8	7,531	422.5	7,239	581.6	4,372	192.8	24,943

Wy. shannoni all demonstrated a preference for site C (Fig. 3). Among the eight *Wy. (Phoniomyia)* species analyzed, three were predominately captured in site A: *Wy. theobaldi*, *Wy. palmata* and *Wy. longirostris*. Another three were captured principally in site C: *Wy. flabelata*, *Wy. splendida* and *Wy. bonnei*. The other two, *Wy. quasilongirostris* and *Wy. davisi*, in site B. Of these, only *Wy. splendida* and *Wy. quasilongirostris* were captured at site D. *Wy. theobaldi* demonstrated a clear preference for site A with $X_w = 5.7$ against $X_w = 1.2$ in site C and $X_w = 0.8$ in site D (Table I, Fig. 3).

Limatus flavisetosus, *Li. durhami* and *Li. pseudomethisticus* were captured exclusively in sylvatic habitats, most frequently at site C (Table I, Fig. 3).

Intra, peri and extradomicile frequency - According to Povolny (1971), the Culicidae found in site D may be classified by their synanthropic degree as: eusynanthropic, hemisynanthropic and asynanthropic.

The first group was represented exclusively by *Cx. quinquefasciatus*, restricted to the captures in site D and totally absent from the sylvatic environments of sites A, B and C. The high degree of synanthropy of this Culicinae becomes evident by the results obtained in the three environments: $X_w = 5.2$ indoors, $X_w = 2.1$ outside the residence and $X_w = 1.4$ around it, in the yard, closer to the forest (Fig. 4).

An. cruzii and *An. fluminensis*, were found invading the residence. For *An. cruzii* the definition as a hemisynanthropic species seems proper, although its greatest preference was arround the residence $X_w = 8.2$, its presence outside and inside it was significant, respectively $X_w = 3.1$ and $X_w = 1.4$. *An. fluminensis* behaved as asynanthropic, with $X_w = 9.9$ around the residence, $X_w = 0.5$ outside and $X_w = 0.1$ inside it (Fig. 4).

Ae. scapularis and *Ae. serratus* behaved at site D in similar ways, with a greater tendency to stay around the residence, other than outside it and or inside it (Fig. 4). *Cq. chrysonotum* and *Cq. venezuelensis* showed the same pattern as these *Aedes*, but with almost 20 times the number of specimens (Fig. 4).

DISCUSSION

Preferences for sampling sites - There are many reports on Culicidae incidence a in the Atlantic Forest areas of the Southeastern Region of Brazil. Forattini et al. (1968, 1978a,b, 1981, 1986a,b, 1987a,b, 1989, 1990, 1993a,b,c, 1995a,b), Guimarães et al. (1989, 1991, 1992), Lopes (1996) and Ferreira (1997) approached the presence of these mosquitoes comparatively in two or more capture sites in the same region. However, the majority of these authors refer to the possible domiciliation processes that the mosquito fauna goes through toward co-habitation with man. In the present study, we comparatively analyzed the presence of mosquitoes in three exclusively forested environment sites.

Comparing sylvatic captures with the captures in the residence, represented by site D, in the Picinguaba Nucleus of PESM, only *An. cruzii*, *An. oswaldoi*, *An. fluminensis* and *Cx. quinquefasciatus* were found preferably in this site. *Ae. serratus*, *Ae. scapularis*, *Cq. chrysonotum*, *Cq. venezuelensis* and *Ru. reversa* presented the higher occurrences in sylvatic environment. *Ps. albipes*, *Tr. digitatum*, *Wy. dyari*, *Wy. mystes*, *Wy. quasilongirostris* and *Wy. splendida* were rarely found in site D.

Forattini et al. (1968) observed that the frequency of *An. cruzii* in residences might vary according to their proximity to the forest. *An. cruzii* has been demonstrates as the transmitter of malaria in Southeastern and Southern areas of Brazil and attacks man both around and inside houses (Deane et al. 1971, 1984, Azevedo 1997). In our samplings, although the greatest occurrence of *An. cruzii* was observed in the residence, its presence

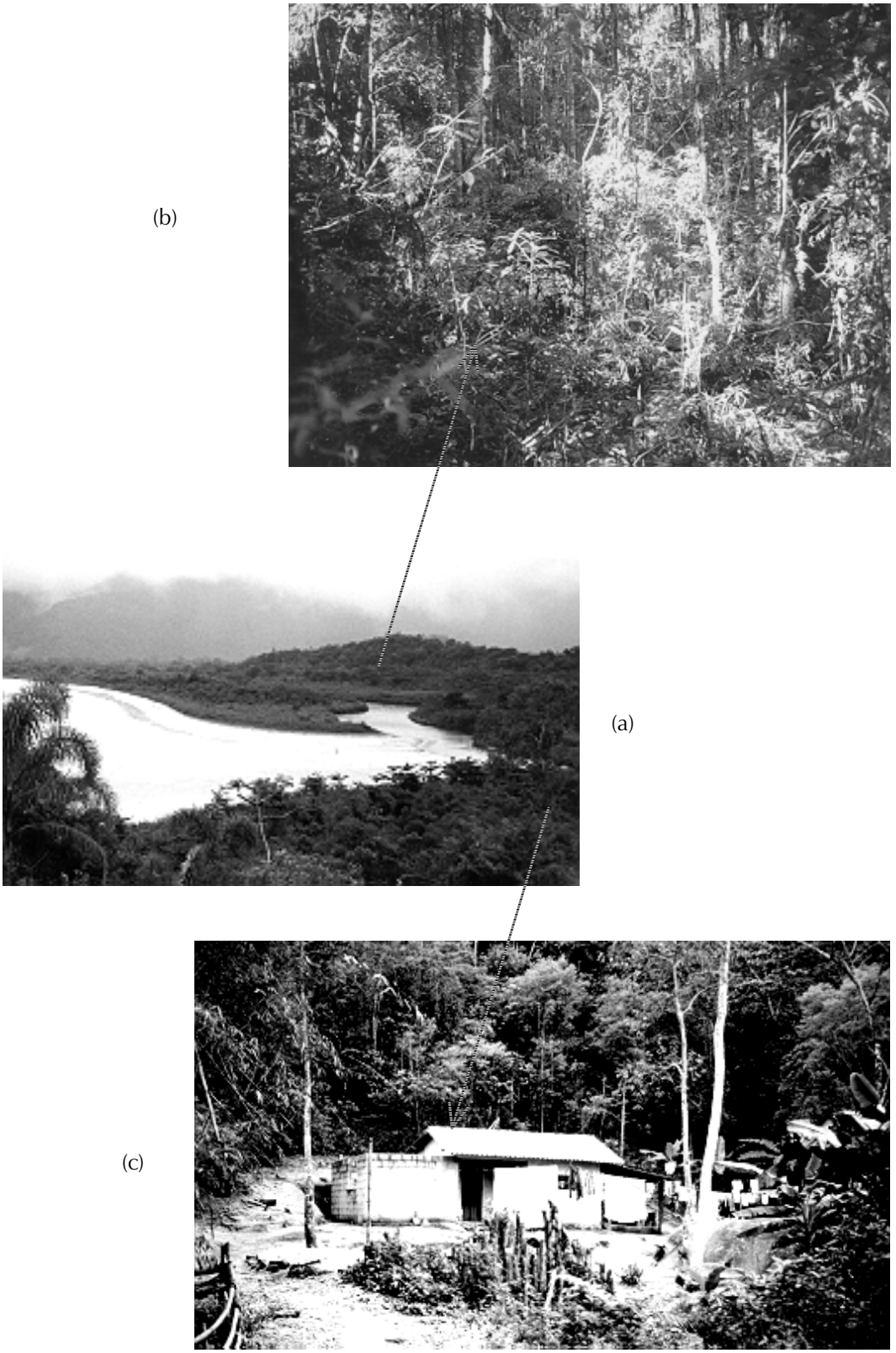

Fig. 2 - a: general view of the Picinguaba Nucleus of Serra do Mar State Park, State of São Paulo; b: highlighting Site C; c: Site D.

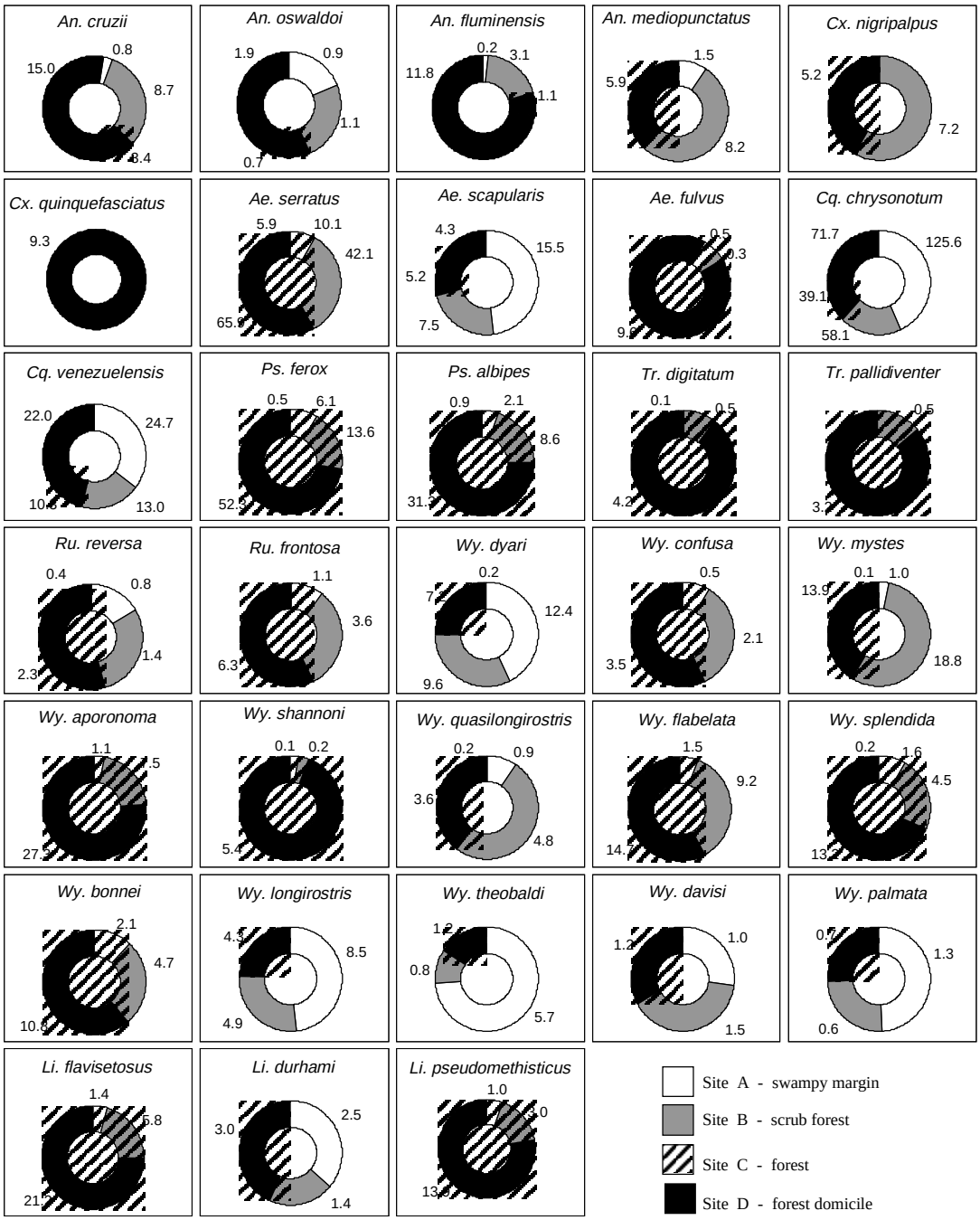

Fig. 3: habitat preferences of Culicidae species, according to calculation of Williams averages (X_w), Picinguaba Nucleus of Serra do Mar State Park, State of São Paulo, January 1991 to December 1992. Site A = swampy margin; Site B = scrub forest; Site C = forest; Site D = forest domicile.

in sylvatic environments was common (Fig. 3). This distribution is in agreement with the observations of Forattini et al. (1990), that described the migratory capacity of this Anophelinae between the forest and residences for the purpose of hematophagic activity. In more recent studies, Forattini et al. (1993a,c) considered *An. cruzii* as asynanthropic even after human occupation and subsequent environmental modification. Although able to invade the domicile for the hematophagic activity, this Anophelinae maintains the sylvatic environment as its natural habitat.

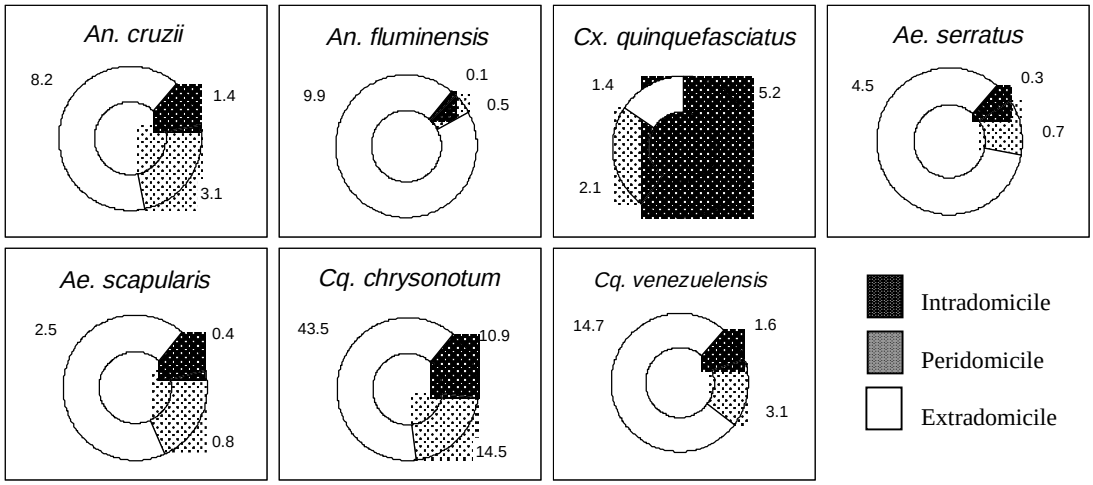

Fig. 4: Culicidae species frequency inside (intradomicile), around (peridomicile) and outside (extradomicile) the residence at site D, according to the calculation of Williams averages, during 18:00-21:00 hr period, Picinguaba Nucleus of Serra do Mar State Park, State of São Paulo, January 1991 to December 1992.

The distribution of *An. oswaldoi* and *An. fluminensis* was similar to *An. cruzii*, although this latter occurred with a lower number of specimens. Lourenço-de-Oliveira et al. (1989), studying Anophelinae in the State of Rondônia, and Ferreira (1997), in the Atlantic Forest of the State of Rio de Janeiro, captured *An. oswaldoi* in the residence surroundings as well as in forested environment. Guimarães et al. (1994) reported occurrences of *An. fluminensis* in forested environment as well as in collections inside residence; in our studies they were captured preferably in the latter (Fig. 3).

Cx. quinquefasciatus is historically considered as a typical urban mosquito (Causey et al. 1945, Deane 1951, 1954, Forattini et al. 1978b, 1993c and Guimarães et al. 1989). In the present study, this was the only truly eusynanthropic species found (Fig. 3). Roberts et al. (1981) and Lourenço-de-Oliveira and Heyden (1986), observed that in rural areas, where houses are distant from each other, *Cx. quinquefasciatus* becomes scarce. However, by the present observations and by Guimarães et al. (1989), we believe that the hypothesis of Forattini et al. (1968) that this mosquito is still adapting itself to these areas should clearly characterize this mosquito behavior in that environment. It should also be considered that the area in which Lourenço-de-Oliveira and Heyden (1986) worked, was flooded and plenty of aquatic vegetation. This environment was highly favorable to the occurrence of other mosquito species in the residence, as for example *Mansonia titillans*, the most abundant species according to these authors.

Caught exclusively in sylvatic situations in our studies (Fig. 3), *Cx. nigripalpus* has demonstrated in other studies a more varied behavior. Lourenço-de-Oliveira (1984) collected this Culicinae in a deeply altered area in the State of Rio de Janeiro and Forattini et al. (1993c) reported its preference for anthropic modified environment. Forattini et al. (1995b) remarked that the behavior of *Cx. nigripalpus* in getting close to residences increases its epidemiological importance, specially because this mosquito has been frequently incriminated as transmitter of the St. Louis encephalitis and was considered so in Vale da Ribeira region, in the State of São Paulo.

There are many reports of *Ae. scapularis* being captured in great number of specimens at sylvatic environment (Davis 1945, Causey & Santos 1949, Rachou et al. 1955, Neves 1972, Guimarães & Arlé 1984, Lourenço-de-Oliveira 1984, Forattini et al. 1986a,b). We also found the greater number of individuals in sylvatic sites. However, it was observed that a great part of this incidence was for site A that, although in sylvatic environment, is an open beach area, and close to locations where man frequents (Fig. 3). If we evaluate the occurrences in sites A and D together, we can better observe the potentiality of *Ae. scapularis* in the domiciliation process whenever man is introduced in sylvatic areas.

Forattini (1961), Forattini et al. (1978a,b, 1981, 1993c, 1995a) and Guimarães et al. (1989, 1994) referred to the significant domiciliation tendency of *Ae. scapularis*. In studies made at Vale da

Ribeira, Forattini et al. (1978b) speculated that the epidemic of encephalitis occurred in that area may have been associated with the incidence of this Culicinae in the residential environment. Forattini et al. (1987b) examining blood found in engorged mosquitoes in this same region, observed that 80% of the *Ae. scapularis* specimens had fed on man.

This study demonstrated that *Ae. serratus* was preferentially captured is sylvatic environments. Previous studies in Brazil have found the same preference (Forattini et al. 1978a, 1981, 1986a,b, 1995a, Guimarães et al. 1992, 1994, Lopes 1996, Ferreira 1997). However, Forattini et al. (1993c) reported that *Ae. serratus* and also *Ae. scapularis* were captured in environments modified by man.

Reports on *Ae. fulvus* incidence referred to them being collected in forested areas where man's activity is not mentioned (Guimarães et al. 1994, Forattini et al. 1995b). Confirming this tendency, *Ae. fulvus* was only present in the captures taken in sylvatic environment, with clear preference for better preserved forest (Fig. 3).

Generally, *Coquillettidia* mosquitoes are considered aggressive, avid blood feeders of man and/or other animals. Perhaps due to this behavior or to their attraction to artificial light, the two studied species, *Cq. chrysonotum* and *Cq. venezuelensis*, were collected in high incidence in the vicinities of the residence in site D (Fig. 3). Guimarães et al. (1989) reported the occurrence of these two species in the residence. Forattini et al. (1978b) reported similar distribution for *Cq. chrysonotum* in residential samplings as well as in the sylvatic ones. Forattini et al. (1978b, 1981, 1986b) and Lourenço-de-Oliveira (1984) captured *Cq. venezuelensis* more frequently in forested areas.

Ps. ferox and *Ps. albipes* maintained in our studies clear preference for the sylvatic environment as demonstrated by others (Forattini et al. 1981, 1986b, 1993c, Guimarães et al. 1989, 1994).

Most Sabethini species occurred preferably in samplings taken in sylvatic environment. The rare presences of some of these species in site D were by chance or due to the search for a blood meal. The willing of *Ru. reversa* to invade site D was also seen by Forattini et al. (1968).

Forattini et al. (1978a), in Vale da Ribeira, also observed that the Sabethini are much more abundant in sylvatic areas. However, the same authors in the same period and location (Forattini et al. 1978b) found rare occurrences of some of them in areas very close to residences. These species were also captured in similar circumstances in the present study (Fig. 3).

We captured *Tr. digitatum* only once at site D (Table I), and *Tr. pallidiventer* was exclusively captured in sylvatic areas. Both species preferred site C, where the forest was denser and more preserved (Fig. 3). Forattini et al. (1986a) found similar incidences for *Tr. pallidiventer* and Guimarães et al. (1994) for *Tr. digitatum*.

Among the *Wyeomyia* species studied, *Wy. dyari* prefered the swampy areas of site A. The occurrences of *Wy. confusa*, *Wy. shannoni* and *Wy. aporonoma* were greatest in denser forested areas (Fig. 3). This data is in accordance to Forattini et al. (1968, 1986a, 1993) and Guimarães et al. (1989) referred to sporadic occurrences of *Wy. confusa* in residences. *Wy. mystes* presented the greatest incidence at forested areas (Fig. 3), as observed by Guimarães et al. (1989).

The *Wy. (Phoniomyia)* species could be divided into groups related to the sampling sites. With significant incidences at sites B and C we found *Wy. quasilongirostris*, *Wy. flabelata*, *Wy. splendida* and *Wy. bonnei*, and at site A, *Wy. longirostris*, *Wy. theobaldi*, *Wy. davisi* and *Wy. palmata* (Fig. 3). *Wy. (Phoniomyia)* lay their eggs almost exclusively in the central water filled cavity in bromeliads. Incidental to the objectives of the present study, we collected immature forms, especially of *Wy. (Phoniomyia)* in site A, in the accumulated water between leaves of many plants. The choice for this alternative breeding site, very frequent in site A, may be related to the greatest incidence of these species.

Forattini et al. (1978a, 1986a, 1993c), Lourenço-de-Oliveira (1984), Guimarães et al. (1989, 1994) and Lopes (1996) reported the capture of these *Wy. (Phoniomyia)* species in sylvatic environment and with vegetation coverage similar to that of the present study. Forattini et al. (1968) referred to the occurrence of *Wy. longirostris* specimens in residences. Similar occurrence was observed for *Wy. quasilongirostris* (Fig. 3).

Guimarães and Arlé (1984) referred to *Li. durhami* as a Sabethini close associated with man because its immature forms are frequently found in artificial breeding sites formed due to human activity as well as hematophagous habits. In our studies, the three *Limatus* species captured, *Li. durhami*, *Li. flavisetosus* and *Li. pseudomethisticus*, followed the observations of Forattini et al. (1978a, 1993c), Lourenço-de-Oliveira (1984), Guimarães et al. (1989, 1994) and Ferreira (1997), that reported them exclusively in sylvatic environment (Fig. 3).

Intra, peri and extradomicile frequency - The presence of man and the accessories indispensable to his survival turns the residence into a place with proper conditions for certain mosquito species. Shelter, guaranteed blood meal, more moderated and constant climatic conditions and, in some cases, the breeding sites, are some of these attractive factors.

Cx. quinquefasciatus, the only truly eusynanthropic species, had more intense presence inside and around the residence, with incidence outside it considered as occasional (Fig. 4). Causey et al. (1945), Deane (1951, 1954), Forattini et al. (1978b, 1987b), Gomes et al. (1987) and Guimarães et al. (1989), in different Brazilian regions, similarly observed the domestic incidence of this Culicinae.

The possible involvement of *An. cruzii* in the transmission of etiologic agents of human and simian malaria in the southeastern and south of Brazil has been reported through the years by many authors. However, with the exception of the observation of Forattini (1961) and Forattini et al. (1968), the majority of the studies did not report an important presence of *An. cruzii* inside the domicile. At most, as in our studies (Fig. 4), the incidences were restrict to the vicinities around the residence or to its interior solely for the purpose of a blood meal (Rachou 1946, Rachou et al. 1958, Deane et al. 1971, 1984, Forattini et al. 1978b, 1993a, Gomes et al. 1987, Azevedo 1997).

Guimarães et al. (1994) captured *An. fluminensis* in different sylvatic locations at PNI and referred to rare occurrences inside the residence. These data, also found in our studies (Fig. 4), and the exclusive preference for sylvatic environments reported by Lourenço-de-Oliveira et al. (1989) in the State of Rondônia, confirm that these rare occurrences inside and around the domicile were sporadic.

The epidemiologic importance of *Ae. scapularis* in the potential arbovirus transmission on the shores of State of São Paulo is supported in our studies by its presence inside and around the residence (Fig. 4). Forattini (1961), Forattini et al. (1978b, 1987b, 1995a) and Guimarães et al. (1989) reported remarkable incidences of *Ae. scapularis* inside the residence and considered it as endophilic. Forattini et al. (1987b, 1989, 1990) and Guimarães et al. (1987) demonstrated that this tendency to residence environment is also based in the great number of *Ae. scapularis* specimens captured feeding on blood of domestic animals and for its remaining around the residence after blood feeding.

Forattini et al. (1968) related significant *Ae. serratus* incidences inside the residence with annual cycles of different sizes. In our studies we verified the possibility of residence invasion (Fig. 4). However, it seems to follow the already observed tendency for living outside (Forattini et al. 1978a, 1981, 1986a,b, Guimarães et al. 1992, Lopes 1996, Ferreira 1997).

Cq. chrysonotum and *Cq. venezuelensis*, especially the first one, were captured indoors with significant incidences (Fig. 4). Guimarães et al. (1989), studying different kinds of residence in the Atlantic forest areas in the State of Rio de Janeiro, referred to the constant occurrence of both species around and inside the residence. However, they remark that the greatest incidences were outside it. This is in agreement with our observations. Shannon (1931) and Giglioli (1948) considered that the presence of *Coquillettidia* species in the residence was conditioned to the proximity to the breeding sites. Yet, in PESM the studied residence was approximately 1,000 m from the breeding sites and so, the occurrences inside and around it demonstrate that, in addition to the strong attraction exerted by light, these mosquitoes are capable of crossing considerable distances in their search for a food source.

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