6 — Nocturnal moth inventory in Malagasy *tapia* woods, with focus on silk-producing species

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In Madagascar, the *tapia* woods (*Uapaca bojeri*) shelter a wide diversity of moth species, among which the *landibe*, a silk moth of the genus *Borocera*. Threatened by diverse pressures – anthropogenic and environmental – its populations have drastically decreased during the last twenty years. We report on night inventories by means of light traps, performed in the *tapia* woods. We observed at least 68 species, notably another silk producing moth, *Europtera punctillata*, whose caterpillars are called *landifotsy* by villagers. We unveiled specific behavioural traits of species sampled during four successive night periods, between 8:00 pm and 4:00 am. Sixty-eight moth species were observed, some of them are silk-producing species, including *landifotsy*.

Inventaire nocturne des papillons de nuit dans les bois de *tapia*, avec une attention particulière pour les papillons producteurs de soie

À Madagascar, les bois de *tapia* (*Uapaca bojeri*) abritent une grande diversité de papillons nocturnes, dont le ver à soie endémique appelé localement *landibe* (*Borocera cajani*). Cette espèce est menacée par diverses pressions – anthropogéniques et environnementales – qui ont mené à la nette baisse de ses populations au cours des vingt dernières années. Nous rapportons ici les résultats d'inventaires nocturnes de papillons en bois de *tapia* menés à l'aide de piégeages lumineux. Notre méthode a permis de mettre en évidence des espèces d'Hétérocères observées au cours de nuits d'inventaires divisées en quatre sessions de comptage entre 20h00 et 4h00. Nous avons pu recenser au moins 68 espèces différentes de Macrolépidoptères, dont certaines sont également productrices de soie, notamment le *landifotsy*. Pour cette espèce, nous avons mis en évidence des données comportementales différentes pour les deux sexes.

6.1. INTRODUCTION

Landibe is an endemic silk moth of Madagascar, associated most of the time to the species *Borocera cajani* Vinson, 1863 (Lasiocampidae) (Razafimanantsoa et al., 2012, chapter 1). Its morphology, life cycle, ecology and biology are well documented (Vinson, 1863; Grangeon, 1906; Paulian, 1953; Razafindraleva, 2001; CITE, 2004; Razafimanantsoa et al., 2012, chapter 1; Razafimanantsoa et al., 2013, chapter 2). On the central tablelands of the Imerina (Itasy region), *B. cajani* develops in *tapia* woods (*Uapaca bojeri* Baill., Phyllanthaceae), the most xerophytic of evergreen forests of the country (Kull et al., 2005), also found in other regions. Local villagers use the cocoons to weave traditional clothes or artisanal scarves destined to the local touristic market (De Lajonquière, 1972; Peigler, 1993; 2004). The *landibe* populations are declining under various pressures, both human and environmental. But silk remains an alternative source of income to people living close to the *tapia* wood, especially during lean periods (Kull et al., 2005; Razafimanantsoa et al., 2012, chapter 1). In Madagascar, natural resources management has been decentralized through a program launched in the nineties. The last phase of this "Environmental Action Plan" (EAP – 2003-2008) consisted in transmitting the responsibility for sustainable development to the local scale. In 2007, this purpose was not completely fulfilled (Andriamahefazafy, 2005; Blanc-Pamard et al., 2007). Most of the environmental protective measures are decided in local communities and concern all non-timber forest products (NTFP), including the *landibe*. Means to protect it are very often restrained to the prohibition to harvest cocoons during key periods of the year, aside from the general ban to cut wood (chapter 17).

In the aim to have an overview of the situation, we performed moths monitoring with light traps, classical devices used for Heterocera sampling e.g. Baker et al., 2011. More than controlling the presence of *Borocera* species, rather difficult to evaluate by means of light trappings (Razafimanantsoa et al., 2006), all species of the known macrolepidopterans' community were monitored, with a particular focus on other (non *Borocera*) silk-moths, e.g. *Europtera punctillata* (Saalmüller, 1884) (*landifotsy*), *Napta serratilinea* (Guenée, 1865) (both Lasiocampidae) and *Antherina suraka* (Boisduval, 1833) (Saturniidae) (Razafimanantsoa et al., 2006; Razafimanantsoa, 2008; Razafimanantsoa et al., 2012, chapter 1). We aimed at comparing two sites with significantly different local resources management practices, in order to show possible differences in habitat fragility using moths as indicators of habitat quality (New, 2004). Our protocol ensured a low level of direct deleterious impacts on sampled individuals and allowed linking a variety of climate variables to species traits. Among these variables, we measured the main ones known as having an impact on flying activity of moths, i.e. moonlight and cloud cover (Williams et al., 1951; McGeachie, 1989; Yela et al., 1997; Butler et al., 1999; Jeyakumar et al., 2007; Nowinszky et al., 2010; Nowinszky et al., 2011; Nowinszky et al., 2012), temperature (McGeachie, 1989; Yela et al., 1997; Butler et al., 1999; Choi, 2008; Young, 2010; Steinbauer et al., 2012) and rainfall or relative humidity (Tucker, 1983; Butler et al., 1999; Choi, 2008; Steinbauer et al., 2012). Whenever possible, we took into account sexual dimorphism in our samplings since behavior towards light traps may differ between males and females: light traps would be more attractive for male moths, while bait traps seem to be more attractive for female moths, probably because they depend on energy-rich food sources for egg maturation (Scoble, 1992). We discuss the main results of trapping sessions and the advantages of our method for further application and improvements.

6.2. MATERIALS AND METHODS

6.2.1. Inventory sites

The two inventory sites were chosen according to the local management of NFTP. The zone of study was about 50 km West of Antananarivo, longitude 47°11' East, latitude 18°58' South, and between 1,200 m and 1,400 m of elevation, i.e. the same zone as in referred to in Razafimanantsoa et al. (2013), chapter 2 (**Figure 8.1**, page 104). The sites, Manarina and Kianjamarina, were located in the *fokontany* of Vatolaivy, at a distance of 12 km West of Arivonimamo, and separated by 4.22 km. They were visited three times each, during three consecutive weeks in February and March 2010. The site of Manarina (22/02, 4/03, 8/03) was characterized by a constant prohibition of cocoon harvest all year long since 2005. The site of Kianjamarina (23/02, 3/03, 9/03), by contrast, was characterized by harvesting practices allowed all year long. The inventories were performed in small valleys surrounded almost entirely by hills covered with *tapia* woods.

6.2.2. Light trap

The same light trap (**Figure 6.1**, see color section) was used on both sites, with equivalent disposition regarding the environment. The system was installed on a fallow land edging rice fields. It faced the closest hillside which was therefore the most illuminated (**Figure 6.2**). The other hillsides were exposed to a lesser extent. The light trap was made of two stakes maintaining a white sheet (height: 1.75 m; surface: 2.5 m^2) vertically, thanks to a wire stretched between them. The first sheet was topped by another, stretched as a hat to protect the system from possible rainy conditions. The lights consisted in two 150 W mercury bulbs. The first one hanged between the hat and the vertical sheet, the second one hanged in front of the vertical sheet, facing the closest hillside. Electricity was powered by a diesel generator.

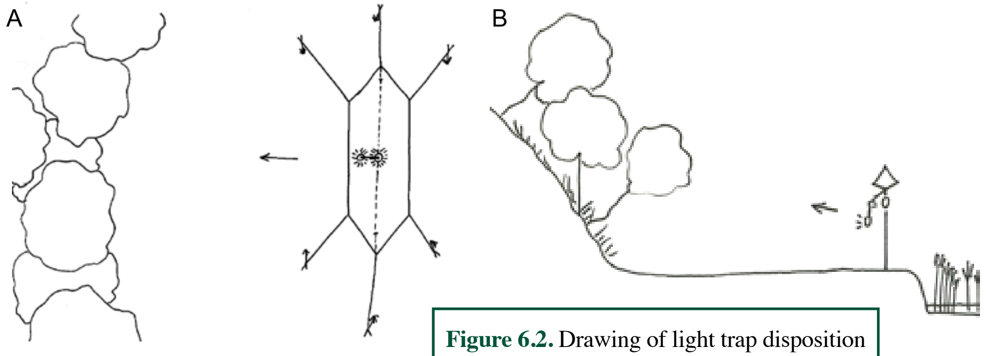

Figure 6.2. Drawing of light trap disposition on the field. The arrow indicates the main direction of light, i.e. towards the trees. A. vertical view; B. lateral view (transect between the hillside and a rice field).

6.2.3. Inventory protocol and recorded variables

Inventories were planned to start effectively in the middle of February, in order to sample the community of moths occurring during the end of rainy seasons' emergence of *B. cajani*. Each inventory night started at 8:00 pm and finished at 4:00 am the next morning. The nights were divided into four counting sessions of two hours, each divided into two phases: a first one devoted to moth attraction and sleeptime for the counters, lasting 1h15, and a second one of 45 min, devoted to counting. For example, from 00:00 to 2:00 am, the attraction period lasted until 1:15 am and the remaining time was used to count. One person was usually enough to count all moths, although a second counter was sometimes needed. Meteorological conditions were taken into account: temperature and relative humidity were measured with a thermohygrometer (temperature: °C, one decimal precision; humidity: %, upper limit: 90%) and recorded every two hours. The presence/absence of the moon was recorded as well, following three categories: 0 if absent, 1 if intermittently hidden by clouds, and 2 if permanently present (perfectly clear night). Knowledge on species specific behavioral trait regarding light of the vast majority of sampled moths was rather poor, this variable being the least easy to control. However, since our work attempted to be essentially comparative, the importance of this factor was limited.

In case of long term monitoring of an endangered local community, attract-and-kill light traps are not realistically a good choice. We therefore had to develop a method to count and release the moths while minimizing negative physical impacts. All species that were directly identified were not captured. However, the number of individuals attracted by the light being very important, care had to be taken to not count one individual twice. The counting had to be fast, efficient, as least deleterious as possible, and non-redundant. All these conditions were gathered with "counting cages" (**Figure 6.3**, see color section). They consisted of transformed flexible clothes hampers in shelters for counted individuals. One face of each cage was covered by a dark and thick cloth sawn all over it, rendering it opaque. A 20 cm^2 opening was cut in the upper half of this face, and the aperture was made closeable with a second piece of cloth slightly larger than the hole, simply with scratches or needles. At the beginning of the inventory nights, two hampers were turned upside down and pinned in the ground with wooden sticks, so that the only way in or out was the cut 20 cm^2 aperture. Inventoried individuals were inserted in the cages progressively, one by one or by groups. This was achieved by connecting a large box containing the caught moth(s) to the aperture. Since light could go through all the other faces of the cages, moths were not tempted to move backward in the aperture. Their fluorescent color increased the attractiveness of inside light-exposed walls, so that moths "jumped" on a free spot on the three light-exposed faces of the cage. This rendered the counting rather fast and efficient. The cages had a volume of approximately 30 liters and a 3 mm mesh. At the end of the inventory nights, right before switching off the generator, they were unpinned from the ground, turned upside down again, and very lightly shaken for moths to start flying away.

6.2.4. Inventoried species

Inventoried species mainly belonged to a list established thanks to previous years of forest light trappings, but we expected to encounter species previously unseen and tried to identify them whenever possible. In this case, individuals were collected (when abundant enough) for further identification. The identifications were mainly based on Dufay (1970), Griveaud (1959; 1961; 1977a; 1977b), Kiriakoff (1969) and Viette (1963; 1965; 1967; 1980; 1990). A few species were newly observed. Among them, 9 could not be identified (2 only observed in Manarina, 2 in Kianjamarina, and 5 on both sites). The classification at family level follows Nieukerken et al. (2011). The adopted Noctuoidea classification follows Kitching (1987), Ronkay (2003), Zahiri et al. (2011; 2012) and Minet et al. (2012). The subfamily classification of the Lasiocampidae is that proposed by Lemaire and Minet (1998). Finally, use of the genus *Maltagorea* is based on Bouyer (1993). Individuals of the Pyraloidea group (*sensu* e.g. Mutanen et al., 2010) were much more abundant than in preliminary forest light traps. Except for species encountered then, we did not inventory individuals of that group, with the hypothesis that they were pledged to the neighbouring fields. We compared the two sites in terms of species richness and abundance. We treated countings of silk-producing species or some of the most abundant species with a χ^2 Goodness-of-fit test according to the period of the night to formulate new hypothesis as to their behaviour. We observed the effect of the presence/absence of the moon on countings. The potential effect of the other factors is discussed in the results section.

6.3. RESULTS

Inventories lasted six nights, and results in the next paragraphs will be considered with regard to that extremely short time frame. They will be part of raw data and hypotheses for further decision to take in projects regarding the conservation of *tapia* woods and their Lepidoptera community. The first of our inventory nights was troubled, during the last collection phase, by a stray dog that destroyed one of the cages, rendering any further counting biased. Data collected during the first three periods was considered in the abundance and richness description of the sites.

Recorded temperatures always decreased during the night, and ranged between 21.7 and 18.5 °C in average, respectively in the beginning of the first and the last counting session. Relative humidity, by contrast, increased during all inventory nights. It usually went higher than 90% as soon as the second or third counting sessions started, except for the first night, during which it was rather low in comparison, and never reached 90%.

Table 6.1 lists all the identified species observed on the two sites. In terms of species richness, the two sites are similar. We collected 55 different species in Manarina and 53 in Kianjamarina, respectively 81% and 78% of the total number of species. In Manarina, 9% of the species caught counted more than 30 individuals, against 8% for Kianjamarina. Two species were overall largely predominant: *Cleora legrasi* (Herbulot, 1955) (Geometridae) was the most abundant of all (n = 349), and *Europtera punctillata* (Lasiocampidae) the second most observed (204 males and 14 females). Then come, in decreasing order of abundance and with more than ten individuals: *Nephele* sp. (Sphingidae, n = 116), *Batocnema coquerelii* (Boisduval, 1875) (Sphingidae, n = 62), *Latoia singularis* (Butler, 1878) (Limacodidae, n = 56), *Nephele densoi* (Keferstein, 1870) (Sphingidae, n = 44), *Trigonodes hyppasia* (Cramer, 1779) (Erebidae, n = 43), *Bizone amatura* Walker 1863 (Erebidae, n = 32), *Anchirithra insignis* (Butler, 1878) (Lasiocampidae, n = 32), *Eilema conspicua* (Rothschild, 1924) (Erebidae, n = 26), *Spilosoma milloti* (Toulgoët, 1954) (Erebidae, n = 23), *Maltagorea fusicolor* (Mabille, 1879) (Saturniidae, n = 22), *Epigynopteryx aurantiaca* (Herbulot, 1965) (Geometridae, n = 21), *Antherina suraka* (Boisduval, 1833) (Saturniidae, n = 14 – incl. one female), *Spodoptera mauritia* (Boisduval, 1833) (Noctuidae, n = 14) and finally *Stemorrhages sericea* (Drury, 1773) (Crambidae, n = 11).

Unfortunately, we did not observe *B. cajani*. However, we found at least two other silk-producing moths, namely *E. punctillata* and *A. suraka*. Very close to *B. cajani*, *E. punctillata* could be very important in terms of silk production. Indeed, the villagers know its caterpillars as *landifotsy* (T.M. Razafimanantsoa, pers. com.). The tendency of *E. punctillatta* to appear on the light trap during the first period(s) of collection is shown on **figure 6.4**. The χ^2 goodness-of-fit tests only reflect visual data. When the test was applied by confronting the first period to the last three grouped together (with adapted theoretical proportions, i.e. 0.25/0.75, df = 1) the test gave the following p- and χ^2 values, by chronological date order: $p = 9.2 \times 10^{-4}$, $\chi^2 = 10.96$; $p = 2.0 \times 10^{-13}$, $\chi^2 = 54.00$; $p = 0.084$, $\chi^2 = 2.97$; $p = 1.1 \times 10^{-8}$, $\chi^2 = 32.67$; $p = 5.3 \times 10^{-13}$, $\chi^2 = 52.08$. When all catches are summed, the χ^2 goodness-of-fit test gives $p = 4.88 \times 10^{-32}$, $\chi^2 = 138.8$ with the same period grouping. The best time to observe these moths is therefore the period covering 8:00 pm until 10:00 pm (provided that the light trapping starts at that hour – we did not attempt any trapping before then). For the third night, the predominant repartition of caught individuals extended to the first half of trapping periods ($p = 0.0001$, $\chi^2 = 14.7$). This trait may be linked to the temperatures, systematically higher during the first periods of counting. **Figure 6.4** also shows increasing catches as the weeks passed, so the flying activity may have been more important the next weeks. Finally, it seems that moonlight decreases the chances to observe *E. punctillata*. We also make the hypothesis that the species prefers high relative humidity, although we do not have enough data to confirm that trait.

Table 6.1. Species observed on the two sites, Manarina and Kianjamarina.

Family	Subfamily	Species	Manarina	Kianjamarina
Limacodidae	Limacodinae	*Latoia albifrons* Guérin-Méneville, 1844		x
		Latoia singularis (Butler, 1878)	x	x
Pyralidae	Pyralinae	*Sindris sganzini* Boisduval, 1833	x	
Crambidae	Spilomelinae	*Stemorrhages sericea* (Drury, 1773)	x	x
Lasiocampidae	Lasiocampinae	*Europtera punctillata* (Saalmüller, 1884)	x	x
		Anchirithra insignis Butler, 1878	x	x
Saturniidae	Saturniinae	*Maltagorea fusicolor* (Mabille, 1879)	x	x
		Bunaea aslauga Kirby, 1877	x	x
		Antherina suraka (Boisduval, 1833)	x	x
Sphingidae	Smerinthinae	*Batocnema coquerelii* (Boisduval, 1875)	x	x
		Gynoeryx meander (Boisduval, 1875)	x	x
	Sphinginae	*Panogena jasmini* (Boisduval, 1875)	x	x
		Coelonia fulvinotata (Butler, 1875)	x	x
	Macroglossinae	*Nephele densoi* (Keferstein, 1870)	x	x
		Nephele sp.	x	x
		Nephele oenopion (Hübner, 1824)	x	x
		Hyles biguttata (Walker, 1856)		x
		Hippotion batschii (Keferstein, 1870)		x
		Hippotion celerio (Linnaeus, 1758)	x	x
		Hippotion geryon (Boisduval, 1875)	x	
Geometridae	Geometrinae	*Pingasa rhadamaria* (Guenée, 1857)	x	
	Ennominae	*Cleora legrasi* (Herbulot, 1955)	x	x
		Epigynopteryx aurantiaca Herbulot, 1965	x	x
Notodontidae	Thaumetopoeinae	*Hypsoides* sp.	x	
Erebidae	Lymantriinae	*Euproctis* sp.	x	x
		Mpanjaka gentilis (Butler, 1879)	x	
		Mpanjaka maculata (Griveaud, 1974)		x
		Mpanjaka sp.	x	
		Lymantica polysticta (Collenette, 1929)	x	
		Stenaroa miniata (Kenrick, 1914)	x	x
	Arctiinae	*Bizone amatura* Walker, 1863	x	x
		Eilema conspicua Rothschild, 1924	x	x
		Eilema griveaudi Toulgoët, 1960	x	
		Eilema sp.	x	x
		Argina amanda (Boisduval, 1847)	x	
		Spilosoma milloti (Toulgoët, 1954)	x	x
	Erebinae	*Nagia promota* (Pagenstecher, 1907)		x
		Cyligramma disturbans (Walker, 1858)	x	x
		Mocis mayeri (Boisduval, 1833)		x
		Mocis nigrimacula (Mabille, 1880)	x	x

Table 6.1. Continued.

Family	Subfamily	Species	Manarina	Kianjamarina
		Trigonodes hyppasia (Cramer, 1779)	x	x
		Ericeia albangula (Saalmüller, 1880)	x	x
		Achaea ebenaui (Saalmüller, 1880)		x
		Trichanua anomala (Berio, 1956)	x	x
Noctuidae	Plusiinae	*Thysanoplusia florina* (Guenée, 1852)	x	x
		Thysanoplusia orichalcea (Fabricius, 1775)	x	x
		Thysanoplusia indicator (Walker, 1858)	x	
		Thysanoplusia ignescens (Dufay, 1968)		x
		Ctenoplusia limbirena (Guenée, 1852)	x	x
		Ctenoplusia vittata (Wallengren, 1856)		x
		Chrysodeixis chalcites (Esper, 1789)	x	x
	Condicinae	*Condica* sp.	x	
	Eriopinae	*Callopistria latreillei* (Duponchel, 1827)		x
	Noctuinae	*Spodoptera littoralis* (Boisduval, 1833)	x	
		Spodoptera mauritia (Boisduval, 1833)	x	x
		Callicereon heterochroa (Mabille, 1879)	x	x
		Appana malagasa (Gaede, 1915)	x	x
		Leucania sp.		x
		Mythimna sp.	x	

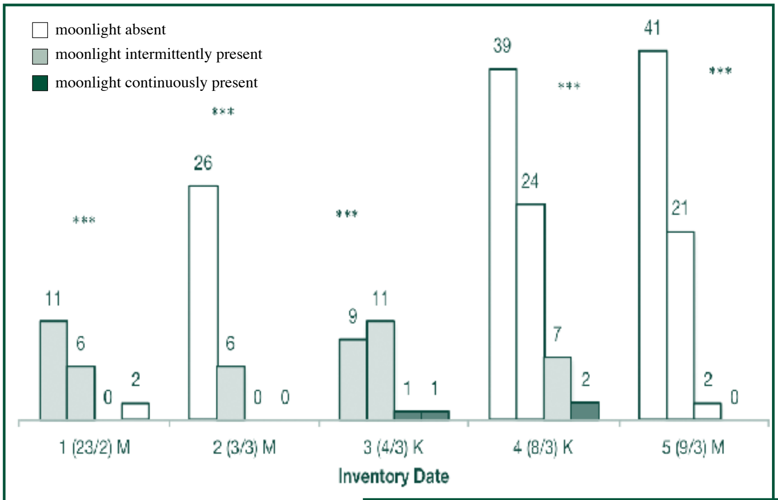

Figure 6.4. Abundance of *Europtera punctillata* moths at different inventory dates (each night is divided in four counting sessions). *Europtera punctillata* tends to appear (stabilized position on the vertical sheet) systematically during the first (or first two) period(s) of the night. M. Manarina; K. Kianjamarina. ***: refers to p-values < 0.001 in each case.

The total number of caught moths regardless of their species is illustrated in **figure 6.5**. The test gave the following p- and χ^2 values, by chronological date order: $p = 6.1 \times 10^{-24}$, $\chi^2 = 101.82$; $p = 5.9 \times 10^{-23}$, $\chi^2 = 102.41$; $p = 1.2 \times 10^{-29}$, $\chi^2 = 127.89$; $p = 9.3 \times 10^{-18}$, $\chi^2 = 78.43$; $p = 1.4 \times 10^{-7}$, $\chi^2 = 28.13$. The abundance of all merged species is strongly correlated with moonlight. It seems to dictate the global community's flight-to-light behavior.

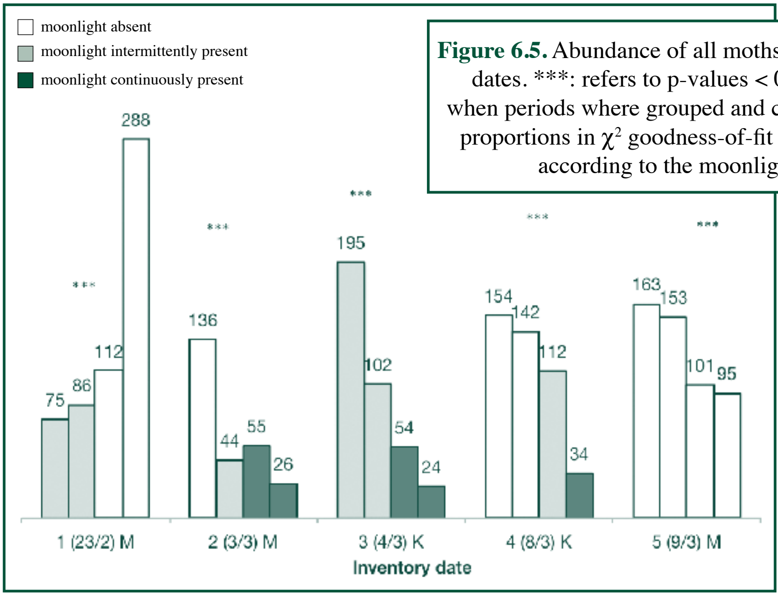

Figure 6.5. Abundance of all moths at different inventory dates. ***: refers to p-values < 0.001, all observed when periods where grouped and compared to balanced proportions in χ^2 goodness-of-fit tests night by night, according to the moonlight category.

Among the newly observed, we counted 30 individuals of a Limacodidae species. They could correspond to *Ximacodes pyrosoma* (Butler, 1882). But this identification attempt has to be taken carefully: no individuals were collected and/or compared to any reference. The individuals counted as *Nephele* sp. matched almost to perfection the allure of *N. densoi*, nevertheless they did not show any white/silver spots on the forewings (Griveaud, 1959). We did not assume they were a different phenotype and kept the distinction along the inventories. Further research on their taxonomic status is therefore needed. The two nights during which they were the most abundant are the first of our inventory series, which means that further research should be preferably done in January and early February.

Since flight-to-light abilities may differ between males and females of one species (Scoble, 1992), sexual dimorphism was accounted whenever possible, and put forward the expected much higher ability of males to reach the trap. This was observed for *E. punctillata*, *A. insignis*, *M. fusicolor*, *A. suraka*, *B. aslauga* and *L. albifrons*, for which the male-female ratios were respectively of 204-14, 24-0, 21-1, 8-1, 7-0, 2-0. For *L. albifrons*, more countings are necessary to confirm the trait difference between males and females. Three other species were sexually distinguished, but male-female ratios or total caught individuals were not significant enough to draw a conclusion out of it: *M. gentilis* (3-4), *E. albangula* (3-2) and *S. miniata* (2-1).

The overall very high number of caught individuals all along the inventories may indicate an ecosystem overloaded with phytophagous moths. Both arbustive and arborescent layers may be subjected to a constant pressure from many of these species. However, their role cannot be clear since behavioral and ecological data are not available for all of them, have not been under focus in this project, and are therefore missing from this study.

6.4. DISCUSSION

We could not show any significant difference in abundance or richness between the two studied sites. A part of the small difference in the percentages listed in the results section could come from the one period of night that could not be inventoried because of the dog incident in Kianjamarina. However, the real limiting factor here seems to be the short inventory time frame. Sites are more commonly compared with trappings that cover several seasons if not all, or during several years, and the management differences of the habitats are usually more marked (Thomas, 1996; Hilt et al., 2005; Fiedler et al., 2012; Sinu et al., 2013). In other words, the data collected here should be compared with new samplings performed during the same season in the next years. The stability of moth communities would be easier to characterize. Transects on both sites should be performed to assess the botanical diversity lying under the canopy, in the *tapia* wood, since the moth community can reflect the plant community (Shuey et al., 2012). Besides, the 9 unidentified species show that the moth diversity in the *tapia* woods has not been entirely described as of now.

The main discussion point is the absence of *B. cajani*. We did not plan to stop inventories so soon, but unexpected issues were encountered and implied a ten days sampling gap. Afterwards, villagers informed us that no more cocoons were noticeable in the forests, which lowered chances to observe any *landibe*. Their absence can be attributed to several causes. There might be a resource competition with any of the observed species caught, but this is unlikely only a matter of availability: villagers often referred to the forests as defoliated by the *landibe* in the past, a phenomenon that no longer occurs and proves that the (main) resource is not missing. Another possibility lies in the nature of our trappings: light inventories previously performed in *tapia* woods were done inside the forest, which may be obligatory for *B. cajani* catching. We adopted another sampling method, outside the forests, in small valleys surrounded by hills. The flying abilities of *B. cajani* in terms of distance may be less important than those of the caught species. Their tendency to follow a light cue may be reduced at distances involved in our samplings, or simply inexistent as hypothesized by Razafimanantosoa et al. (2006). These are the two behavioural hypotheses we stipulate. Combined, they could perfectly explain the absence of moths, if the adult stages were indeed present. The absence of *landibe* can also mean that on the two sites, the management of forest resources is, as yet, insufficient to maintain or revive the populations (whether the original cause of decline is linked to anthropogenic pressure or not). However, day transects performed in the forests by other researchers prove the presence of larvae and cocoons on the field during our investigations. We may therefore have missed the real emergence from one or two weeks, maybe less.

It seems that females of Lasiocampidae species observed here had difficulties/no interest to reach light traps out of the forest, as illustrated notably by the poor number of females in the catches of *E. punctillata* and *A. insignis*. The sex-ratios listed here are only indicative and do not reflect the real male-female ratios of the populations in place, which would have to be investigated by other means (Albermatt et al., 2009). However, if the flying ability (in both males and females) was the limiting factor in reaching the trap, it would mean that one species trait itself could prevent from efficient expansion. Going out of the forest would not be possible, and reproduction/expansion would be reduced and governed by habitat fragmentation for such species. If this is the case of *B. cajani*, a relatively high density of individuals is needed for efficient maintain of local population, i.e. the species is characterized by a strong r-type reproductive strategy inside its community (Pianka, 1970), a strategy rendered inefficient by the recent prolonged pressures undergone by the species. One key piece of data is therefore still missing: the actual flying range of *B. cajani*. Mark-release-recapture should be rather hard to set without any tool to pre-catch the adults. Elucidating the nature of their sex pheromones could help on that way, by means of rearing, since they can be maintained (Razafimanantsoa, 2008). Besides, sex pheromones could be used as an efficient monitoring tool since light traps have proven inefficient up to now, and other inventory techniques could be needed (Razafimanantsoa et al., 2013, chapter 2)

The results concerning *E. punctillata* and other silk-producing species are very encouraging and should be investigated deeper in terms of population density, availability, and propensity to be used as additional income source for villagers, all with a sustainable approach.

In any case, our protocol showed efficiency at sampling tremendous quantities of individuals, and at spotting their emergence period during the night. It should be reused and planned during the ideal periods for *B. cajani* or *E. punctillata*. As such, our protocol presented several advantages. Firstly, when approaching a light source, moths usually go through a series of agitation steps, before settling and calming down. During the attraction phase, there was enough time for moths to reach that calming point, which eased their counting. The counting phase therefore started with an inventory of "stabilized" individuals, and ended with a recently stabilized one. Secondly, it allowed counters to take rest during the inventory work. Counting nights being usually consecutive, this was important, since daytime temperatures were not adequate to sleep. Globally, our technique might be used to compare similar ecosystems described as declining such as suggested by New (2004), i.e. *tapia* woods from different regions of Madagascar, and to acquire behavioral information for a wide variety of moths. Our data may serve the study of the impact of habitat fragmentation on moths inhabiting the endangered *tapia* woods. Such studies can only be launched with a minimum of knowledge on the flying range of the concerned species (interspecific differences and male/female as well) and natural male/female ratios (New, 2004). Although we still have no idea of the flying range of *B. cajani* in particular, and to a lesser extent, of other silk-moths of the *tapia* woods, we have acquired data concerning *E. punctillata*. It and other known silk-moths of the forests could be of great use in future years for the development of alternatives to the use of *B. cajani* (Razafimanantsoa et al., 2013, chapter 2). We have shown its privileged flying hours, and even if we did not use as an indice the lit proportion of moon surface such as described in Steinbauer et al. (2012), we showed that full moon periods should be avoided for detection of that species, by means of light traps. We have shown the same for the whole moth community, which in average avoids light trap when moonlight is optimal. The behavioral traits regarding moonlight were expected since they have been reported for long (Williams et al., 1951; McGeachie, 1989). Their propensity to serve silk production should be investigated. Their biological cycle should be reviewed, and the capacity of villagers to differentiate their silky cocoons from those of *B. cajani* should be checked as well. In the meantime, any existing means to maintain the ecosystem in its integrity should be resorted to before reaching a forest degradation point of no return.

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