

USING CAMERA TRAPS AND DIGITAL VIDEO TO INVESTIGATE THE IMPACT OF *AETHINA TUMIDA* PEST ON HONEY BEE (*APIS MELLIFERA ADANSONII*) REPRODUCTION AND ABILITY TO KEEP AWAY ELEPHANTS (*LOXODONTA AFRICANA CYCLOTIS*) IN GAMBA, GABON

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Bees and elephant interactions are the core of a conservation curiosity since it has been demonstrated that bees, one of the smallest domesticated animals, can keep away elephants, the largest terrestrial animals. Yet, insects' parasites can impact the fitness and activity of the bees. Since their activity is critical to the repellent ability against elephants, this study assessed the impact of small hive beetles (*Aethina tumida*) on bee (*Apis mellifera adansonii*) reproduction and ability to keep forest elephants (*Loxodonta africana cyclotis*) away. Because interspecies interactions are not easy to investigate, we have used camera traps and digital video to observe the activity of bees and their interactions with wild forest elephants under varying conditions of hive infestation with the small hive beetle, a common bee pest. Our results show that queen cells are good visual indicators of colony efficiency on keeping away forest elephants. We give evidences that small hive beetles are equivalently present in large and small bee colonies. Yet, results show no worries about the use of bees as elephant deterrents because of parasitism due to small hive beetles. *Apis mellifera adansonii* bees seem to effectively cope with small hive beetles showing no significant influence on its reproduction and ability to keep elephants away. This study also reports for the first time the presence of *Aethina tumida* as a constant beekeeping pest that needs to be addressed in Gabon.

Key words: *Aethina tumida*, camera trap, elephants, Gabon, honey bees

Introduction

Beekeeping has been widely promoted as a poverty alleviating activity and elephant deterrent (King et al., 2009; Amulen et al., 2017). Bees and elephant interactions are an interesting conservation curiosity as insects can keep away the largest terrestrial animal, 2.4×10^7 times their size, while still producing honey (King et al., 2011, 2017). Recently Ngama et al. (2016) reported on bee deterrence ability against elephants pointing out activity and fitness as key elements, and hence parasitism as a potential limiting factor. Honey bee colonies are superorganisms which first invest in survival and growth, and later commit resources to reproduction once the number of workers in the colony surpasses a reproductive threshold (Smith et al., 2017). While the last reproduction stage is rearing new queen bees, many other steps are required and indicate the level of fitness of the colony, the first form of reproductive investment being the building of specific beeswax comb with cells large enough to breed male bees called drones (Smith et al.,

2017). During reproduction and the whole growth process honey bees also host a wide range of parasites including *Aethina tumida* Murray, 1867, known as the small hive beetle (SHB) (Cosoroaba et al., 2008; Dosselli et al., 2016).

SHB is a generalist parasite native to sub-Saharan Africa. It feeds on fruits and meat but also on energy stocks of honeybees, bumblebees and stingless bees (Cribb et al., 2013; Neumann et al., 2016; Fabre Anguilet et al., 2017). SHBs are usually considered a minor pest in Africa (Neumann et al., 2016). Yet, SHBs are able to feed on food stocks of colonies. Via direct consumption of stored honey and pollen, drilling through combs and defecating, SHB larvae directly impact the levels and quality of energy stocks in colonies (Neumann et al., 2015). They are also known to induce a reduction in fitness of the colonies if not a total collapse of the bee population and colony desertion (Neumann et al., 2016; Fabre Anguilet et al., 2017). We thus found worth to know what happen in bee and elephant interactions when bee colonies suffer parasitism from SHB.

As interspecies interactions are not easy to visually observe and study especially in the forested tropical environment, camera traps and digital video (CT&DV) might prove useful in such contexts especially with regard to elephants (Chaiyarat et al., 2015; Ngama et al., 2016; Smit et al., 2017; Ngama et al., 2018). That is why we decided to use these devices to study bees (*Apis mellifera adansonii* (Latreille, 1804)) and forest elephants (*Loxodonta africana cyclotis* Matschie 1900) interactions. CT&DV are currently widespread because of technological advances. CT&DV are modern society staples which can document every aspect of life (O'Connell et al., 2011; Trolliet et al., 2014). The rapid adoption of CT&DV in conservation and related sciences provokes tremendous changes in wildlife survey methodology in diverse habitats (Burton et al., 2015, Howe et al., 2017). CT&DV are increasingly used to assess activity patterns, occurrence, abundance and behaviour of a diverse range of mammal species and other taxa with reliable results (Howe et al., 2017; Raíces et al., 2017; Nenov et al., 2018; Zlatanova & Popova, 2018).

The aim of this study is to assess the effect of SHB in bee fitness in the context of using beehives to deter elephants. As fitness and both guardian and foragers activities are crucial for an efficient nest defense (Neumann et al., 2016; Smith et al., 2017), it is important to investigate the impact of SHBs on bee reproduction and their ability to keep elephants away. We first predicted that sites with colonies suffering SHB parasitism will have more elephant visits than sites with no parasites. Both bee reproduction (Smith et al., 2017) and elephant deterrence (Ngama et al., 2016) are performed by populated colonies. We therefore secondly suspected that less elephant detection may be recorded in sites protected with colonies having queen cells as indicator of fitness in the colony.

Material and Methods

This study was carried out in plantations and forests near the town of Gamba (1°55'S, 9°50'E) in the Gamba Complex of Protected Areas in southwest Gabon. This Complex of Protected Areas consists of two national parks (Loango, 1550 km² and Moukalaba-Doudou, 4500 km²) that are longitudinally divided by an «industrial corridor» called the Rabi-Ndongo Protected Area (3500 km²) where oil companies operate (Lee et al., 2006; Ngama et al., 2016). This area is characterised by lowland tropical rain forests with high species richness including one of the largest forest elephant populations

(Thibault et al. 2001; Alonso et al., 2006; Blanc et al., 2007). This experiment was part of a larger one and followed established methods by Ngama et al. (2016), with current experiments focusing only on beehives occupied by bees.

Experimental trees and beehives

Beehives were initially placed at four adult trees of *Irvingia gabonensis* (Aubry-Lecomte ex O'Rorke) Baill. and three of *Sacoglottis gabonensis* (Baill.) Urb. species, whose fruits are known to be eaten by forest elephants which frequent these tree places to collect fallen fruits (Morgan, 2009; Blake et al., 2009), in forests nearby the town of Gamba (Fig. 1). Trees were chosen based on active trails and fresh dungs of elephants around trees. Trees were also chosen based on their high and canopy cover similarities which indicate fruit production equivalence, and thus similarity on elephant attraction abilities. Two hives were used to protect each of the seven experimental trees from elephants in November 2011. A modified Langstroth hive model was used to construct beehives from Bilinga wood (*Nauclea diderrichii* (De Wild.) Merr.) (Van Westendorp, 2006). Beehives were treated with a bee swarm attractive cream (Le charme des abeilles, [®]ICKO) during the first three months. Beehives were monitored weekly through February 2013.

Camera trapping to monitor elephant presence

Camera trapping was used to monitor the presence of elephants at *Sacoglottis* and *Irvingia* trees (Fig. 1 and Fig. 2). Following well-established methods from O'Connell et al. (2011) and Trolliet et al. (2014), a camera trap (Rapidfire RC55, Reconyx, Holmen, Wisconsin) was placed at about 15 m from experimental *Sacoglottis* and *Irvingia* trees equipped with beehives to capture elephants when present (Fig. 2). Cameras were set to take one image every two seconds (2 s) when triggered by animal movements. As we were not able to visit experimental sites on a daily basis we did not set the video option of camera traps to allow a long lasting use of batteries and memory cards. To obtain suitable photographs of individual elephants, camera traps were mounted on trees at a 1.5 m height and oriented straight towards *Sacoglottis* and *Irvingia* trees (Fig. 2). Cameras were left in the field 24 hours a day, seven days a week for 17 months. Every week, images were scrutinised manually to identify elephant trap records and a database of all camera trap images

of elephants was created in Excel. An elephant trap record or elephant detection (ED) was one or more photo captions of one or more elephants present at the experimental sites. As distinguishing individual elephants by night was not always possible, we considered ED events as different when separated by a minimum lag time of 45 min based on observations during the whole study. In the experimental sites elephants needed at least 45 min to go from an experimental tree to another place to collect fruits before coming back to the same experimental tree. Thus, two ED events separated by at least 45 min were set as different. As parasitism is related to bee colonies, we report only data from sites where beehives were occupied by bees.

Monitoring bee reproduction and SHB presence

Both beehives of a same tree were hung in opposite sides of the trunk at 1.2–1.5 m above ground (Fig. 2a) to allow beehive manipulations without removing them from the trees. In addition to visits to check the devices, the health of the bee colonies was monitored. Biometric parameters were recorded including parasitism, reproduction and colony growth (Fig. 3). For that each beehive was opened and the presence or absence of SHBs recorded as well as the presence or absence of bee drone individuals (BD) and queen cells (QC) in

hives (Fig. 3). Colony reproduction was assessed only through the presence of queen cells (QC) in hives and not on drone (bee male) presence as drones can be also present before the reproductive stage of colonies (Smith et al., 2017). As parasites can damage bee colonies (Seeley et al., 1982; Cosoroaba et al., 2008) adults and larvae of SHBs were recorded then manually removed from hives as much as possible.

Digital video to monitor bee colony size

A digital video camera was used to monitor bee activities and colony size every week. Honey bee colony duties are hierarchical with two kinds of bee workers performing external duties, specifically those guarding the nest known as «guardians» and those collecting nectars and other food resources known as «foragers» (Hunt, 2007; Grozinger et al., 2014; Smith et al., 2017). Colony size and defensive ability are related to the number of those two kinds of bees in such a way that the greater the number of active bees the more a colony is growing and efficient in defending its nest and surrounding area (Pearce et al., 2001; Hunt, 2007; Ngama et al., 2016). The numbers of guardians as well as forager flights thus were used to determine colony sizes (CS). CS was calculated according to the following formula:

$CS = \text{number of guardians} + \text{number of forager flights}$

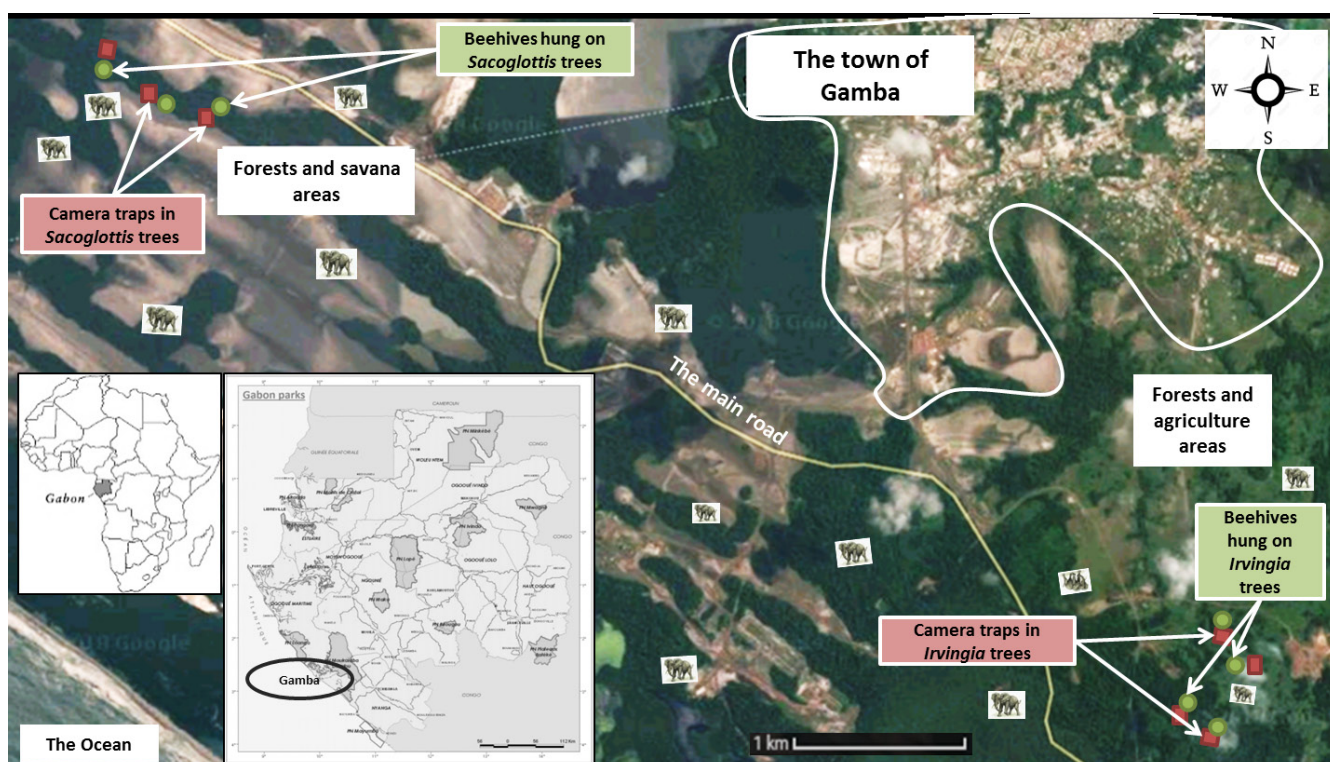


Fig. 1. Map of the study area with experimental sites. Position of each experimental site is marked. Each experimental site indicates the tree, camera, and the two beehives. Adapted from Gabon Parks (2012) and Google map (2018).



Fig. 2. Images of an elephant detection event at a *Sacoglottis* tree with occupied beehives during the fruiting period. Image (a) shows a team member with a bee suit taking a video of numbers of guardian and forager bees at the entrance of an occupied beehive. Images b–h show an elephant trying to collect fallen *Sacoglottis* fruits near occupied beehives two day after capturing image (a). The elephant was not able to collect fruits at that site and left a few minutes after its arrival (images b–h).

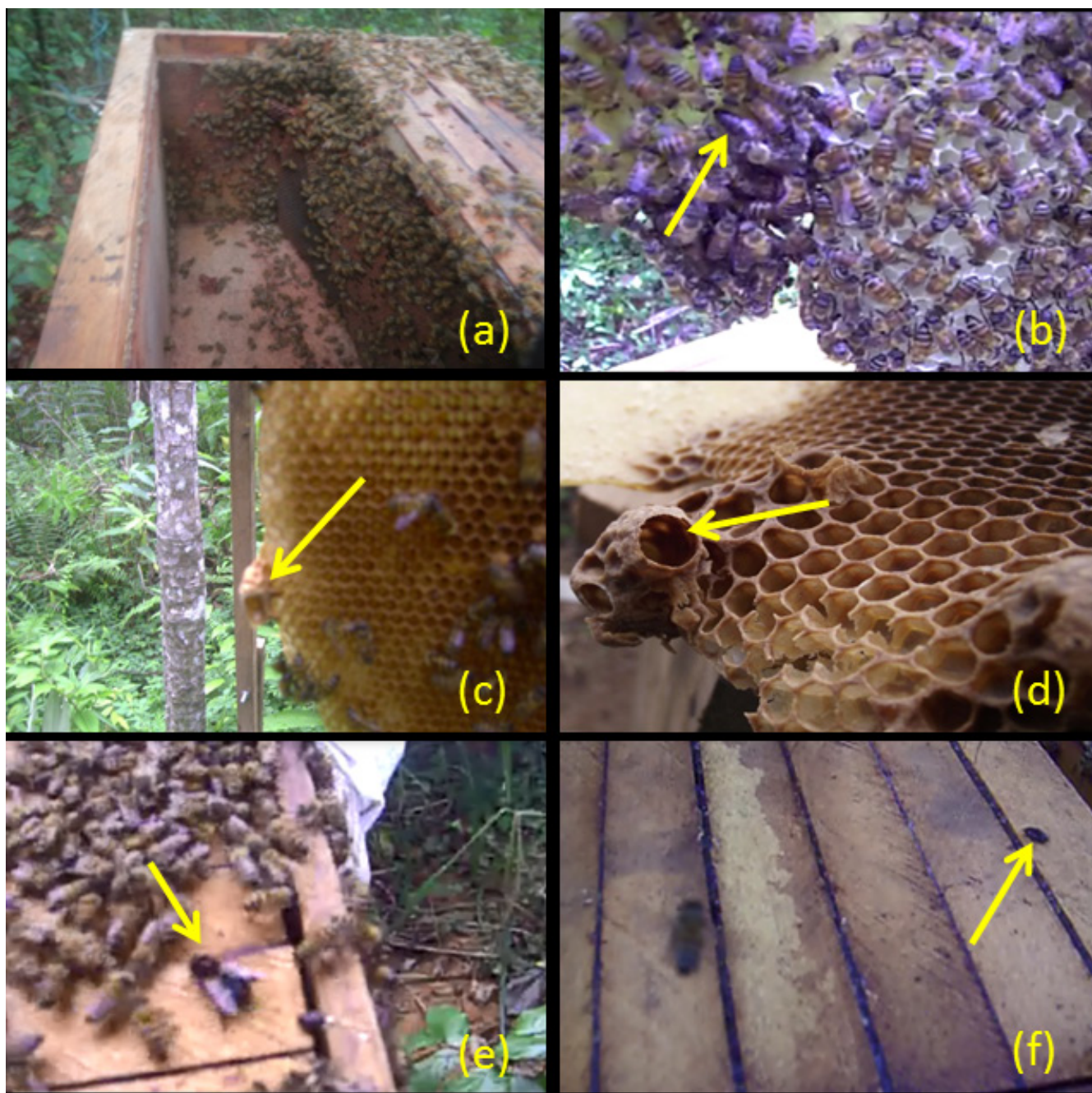


Fig. 3. Indices of bee reproduction and parasitism. Image (a) shows an open beehive during colony fitness and parasitism monitoring. Photo (b) shows a queen bee among workers. Images (c) and (d) show queen bee cells (QC). Image (e) shows a drone bee (BD) among workers and image (f) shows a small hive beetle (SHB) on the top of an experimental beehive.

Numbers of guardians and forager flights were measured by counting bee guardians and forager flights using the slowdown speed video mode of a Canon PowerShot S3IS digital camera. For that, the digital camera was used to make a short video of 1–2 min length at the entrance of each occupied beehives (Fig. 2a). Bees in small colonies spend less time outside the nest than do large colony bees (Smith et al., 2017). Small colonies were more convenient to visually count (see Fig. 4b, Fig. 4c) with guardian numbers and forager flights usually less than 200 individuals. In contrary, large colonies

were difficult to visually count, showing numbers of bee guardians and worker flying larger than 200 (see Fig. 4d). Thus, studied colonies were classified as «large» ($CS > 200$) or «small» ($CS < 200$).

Statistical analyses

MS Excel (Microsoft Corp) was used to compute data and @R (version 3.4.3; R Core Team, 2017) software was used to perform all statistical analyses. As samplings relied on many ecological unknown constrains, we chose to combine linear mixed modeling (LMM) and non-parametric

Kruskal Wallis ANOVA tests to test our hypotheses. The LME4 package was used to fit LMMs where months and sites were treated as random effects to account for autocorrelations that could be associated with changes on fruiting periods and sites specificities (Zeileis et al., 2008; Bolker et al., 2009). Shapiro-Wilk normality tests on model residuals were used to compare the goodness of fitting of models on our data; while Akaike information criterions (AIC) were used to compare models.

To determine whether sites with colonies suffering SHB parasitism had more elephant visits than sites with no parasites we compared numbers of ED events according to the presence or absence of SHB in beehives. In addition, the presence of SHB was compared between large and small colonies as well as between colonies with and without QC. We also compared SHB presence according to BD presence or absence.

To assess if less ED were recorded in sites protected with colonies having bee queen cells (QC)

we compared numbers of ED events according to the presence or absence of QC. We additionally compared ED according to CS, i.e. between sites having large colonies and those having small colonies. We also compared ED according to BD presence or absence.

After comparisons, we were interested to know which factor had the greatest effect on bee ability to deter elephants. This kind of information is necessary as it is helpful in prioritising factors according to their effect extents. Effect extents of factors could be assessed through group and mean comparisons only when data have been collected under the same conditions; but that is not the case in most ecological contexts as ours where several unknown factors exist. The use of linear modelling methods help overcome these limits (Bolker et al., 2009; Zeileis et al., 2008). For that, LMMs were used to see effects magnitudes of CS, BD, QC and SHB on ED. Models were fitted according to the following formula:

$$Y_{ED} = QC + CS + BD + SHB + (1|Months) + (1|Sites),$$



Fig. 4. Appraisal of numbers of bee guardians and forager flights. Image (a) shows an empty beehive. Photo (b) shows a newly established colony (small colony) without guardians at the entrance and only two forager, one leading and the other coming out. Image (c) shows a well-developed colony with many guardians at the entrance and a forager leaving, but also considered as a small colony. Image (d) shows a large colony in the reproduction stage with more than 200 guardians and foragers at the entrance. Yellow arrows indicate foragers flying.

where Y_{ED} are the number of camera trap elephant detection (ED) events, QC indicates the presence of absence of queen cells in colonies, CS indicates the size (large or small) of colonies, BD indicates the presence or absence of bee drones while SHB indicates the presence or absence of SHB pests in colonies. $(I|Months)$ and $(I|Sites)$ indicate that «Months» and «Sites» are treated as random effects in models.

For all comparisons we used Kruskal Wallis ANOVA tests at 95% significance threshold. Probabilities (Pr) of LMMs were used at 90% significance threshold to assess effect magnitudes of factors.

Results

During the trial, a sampling effort of 2394 camera trapping-days was recorded. Bees started to occupy beehives at week 10 till the end of the experiment totaling 61 trial weeks. Fifty-four events of camera trap elephant detections were recorded in trees equipped with occupied beehives. In addition, 342 videos (or observations) of bee guardians and forager activities were recorded during the same period. From this total 50 videos were recorded in large colonies (i.e. Fig. 4d) and the rest (292 videos) in small colonies (i.e. Fig. 4b and Fig. 4c). During the experiment, SHB presence in beehives was not recorded 17 times (over 342 observations) between one to three months of bee establishment in related beehives. During the rest of the observations (325) SHBs were present in all colonised beehives (i.e. 100% of presence) usually after three months of bee establishment.

There was no difference between elephant detection events at sites with bee colonies suffering SHB parasitism and those not parasitised (Kruskal-Wallis $X^2 = 0.001$, $df = 1$, $p = 0.96$) (Table 1). In addition, SHB presence in large colonies was not different from that in small colonies (Kruskal-Wallis $X^2 = 1.1$, $df = 1$, $p = 0.3$) (Table 1). SHB presence was not different in colonies having queen cells from those not having queen cells (Kruskal-Wallis

$X^2 = 1.8$, $df = 1$, $p = 0.18$) (Table 1). Yet, SHB presence was higher in colonies without drones than in those with drones (Kruskal-Wallis $X^2 = 5.7$, $df = 1$, $p = 0.02$) (Table 1).

When assessing if less elephant detections were recorded in sites protected with colonies having bee queen cells (QC), results showed that more elephants were detected in sites with colonies devoid of queen cells than those having queen cells (Kruskal-Wallis $X^2 = 4.9$, $df = 1$, $p = 0.03$) (Table 1). Elephants were also more often detected at sites with small colonies than those protected with large colonies (Kruskal-Wallis $X^2 = 3.8$, $df = 1$, $p = 0.05$) (Table 1). Yet, there was not a difference of elephant detections between sites with colonies having drones and those without drones (Kruskal-Wallis $X^2 = 1.06$, $df = 1$, $p = 0.3$) (Table 1).

Finally from LMMs results, values of estimates show that apart from the presence of QC all factors increased ED (Table 2). LMMs results also show that only the presence of BD had a significant effect (Pr = 0.06, at 10% confidence) on elephant presence at beehives and increased ED by 22% (Table 2). Yet, when models were competed between them, the model encompassing all factors ranked the lowest (Table 3). Models of QC and CS ranked higher followed by SHB (Table 3).

Table 1. Summary of results from Kruskal-Wallis non-parametric ANOVA tests. Numbers in the same columns with same letters are not significantly different at 5% confidence level. n = number of observations in beehives

		Small Hive Beetle (SHB)	Elephant Detection (ED)
Colonies ($n = 342$)	Large ($n = 50$)	49 ^a	1 ^a
	Small ($n = 292$)	280 ^a	53 ^b
Queen cells	Present ($n = 62$)	50 ^a	0 ^a
	Absent ($n = 280$)	279 ^a	54 ^b
Drones	Present ($n = 135$)	123 ^a	23 ^a
	Absent ($n = 207$)	206 ^b	31 ^a
SHB in colonies	Present ($n = 325$)	–	52 ^a
	Absent ($n = 17$)	–	2 ^a

Table 2. Results of linear mixed model following equation (2) and showing the effect extents of factors. It examined how factors explain the detection of elephants at experimental sites. The model was fitted to predict elephant detection at beehives according to small hive beetle (SHB) presence, bee drone (BD) presence, queen cell (QC) presence and colony size (CS). Probability (Pr>|t|) significance of factor effect extent was taken at 10% confidence

Variables	Variable modalities	Estimate	Standard Error	Degree of freedom	t-value	Pr(> t)
	Intercept	-0.08	0.324	270.7	-0.232	0.817
QC	present	-0.24	0.223	326.7	-1.083	0.280
CS	small	0.12	0.24	330.6	0.484	0.629
BD	present	0.22	0.113	250.7	1.928	0.06
SHB	present	0.12	0.202	333.8	0.585	0.559

Table 3. Results of fitted models. Models are fitted to predict elephant detection at beehives according to queen cell (QC) presence, colony size (CS), bee drone (BD) presence, and small hive beetle (SHB) presence. AIC criterions are used to compete goodness of models: the lowest the AIC criterion the highest the rank of goodness of models

Fitted Models	AIC	Ranks of goodness
ED = QC+CS+BD+SHB+(1 Months)+(1 SITES)	845.8	5
ED = QC+(1 Months)+(1 SITES)	838.8	1
ED = CS+(1 Months)+(1 SITES)	839.1	2
ED = BD+(1 Months)+(1 SITES)	841	4
ED = SHB+(1 Months)+(1 SITES)	839.9	3

Discussion

In this study we document on how CT&DV is a useful tool to record understanding of bee and elephant interactions. We provide evidence of SHB pest presence in large and small bee colonies and of queen cell presence as indicator of colony efficiency for deterring elephants.

The use of beehives as elephant deterrent has been classified among biological mitigations by Hoare (2012). As a biological method the use of bees is fraught with many challenges (Karidozo & Osborn, 2005; Hoare, 2012). While investigating the effect of SHB in this experiment, SHB presence was not different in colonies having queen cells and those not having queen cells. The results did not show either a difference between elephant detection events at sites with bee colonies suffering SHB parasitism and those not parasitised. This means that SHB has no effect on bee reproduction or bee ability to keep elephants away. This is in accordance with Neumann et al. (2016) who state that African honey bees are able to cope with the small beetle parasite. During the experiment, after three months of bees establishment in beehives, 100% of beehives were parasitised with SHB being present in both large and small colonies, much more than the 60% reported by Fabre Anguilet et al. (2017). This large percentage of parasitism by SHB was recorded in this experiment mainly because beehives were monitored over time allowing us to observe most of happening changes. That was not the case in Fabre Anguilet et al. (2017) study conducted in colonies living within natural cavities and which had not been monitored over time. Thus they may have been observing more newly established colonies than us. This enhances once more the relevance of longitudinal studies in better explaining ecological phenomena (Bolker et al., 2009; Ngama et al., 2016). Yet, results from LMMs showed the model with all studied factors having the lowest rank. This means that others influencing factors are missing in this study. Hence, factors

such as periods of food source abundance for bees (Smith et al., 2015) may influence SHB parasitism as more resource stock in colonies favour SHB establishment (Neumann et al., 2016). For that, additional investigations which will take in account more factors are needed.

Elephants were detected more often at sites with colonies devoid of queen cells than those having queen cells. There was no difference of elephant detections between sites with colonies having drones and those without drones. These results show that while the presence of drones is not a good indicator of bee efficiency in keeping elephants away, the presence of queen cells in beehives is. SHBs were also more present in colonies without drones (Table 2). This is in accordance with Smith et al. (2015) who showed that drone cells are used for storing honey when it is not time to breed drones. SHB may benefit from drone cells in the absence of drones by feeding on extra food (honey and pollen) stored inside to multiply or simply by hiding from aggressive bee workers (Neumann et al., 2016). While no differences were found between the number of elephant detections at parasitised sites (52, n = 325) and the other sites (2, n = 17) (Table 1), the fitted model with SHB ranked third, indicating that its impact on the ability of colonies to deter elephants might not be neglected. This effect of SHBs in models predicting elephant detection could also indicate the presence of other ecological factors (linked to SHB presence) yet to be identified. Further investigation is needed to confirm these results while taking in account factors such as the desertion behaviour of honey bees, the effect of bee predators or diseases transmitted/facilitated by SHB if they exist. As SHB are common pests, future research on whether SHB densities affect bee ability to defend their nest, their growth and reproduction would also be useful.

SHB are reported to be endemic in Africa and present in wild bee colonies (Fabre Anguilet et al., 2017). To the best of our knowledge, the presence

on SHB in beekeeping in Gabon is not yet reported (Hauser, 2003; Neumann et al., 2016). Further research on the impacts of this pest on beekeeping in Gabon is needed to better use beehives to deter elephants. In addition, reproductive colonies breed large number of workers (Fig. 3) in order to give birth to new colonies (Smith et al., 2015). Such large number of worker increase activities and the defensive ability of bee colonies (Delaplane et al., 2013). This may explain matches between the presence of queen cells in colonies and the little detection of elephants in experimental sites. Moreover, large colony presence also matched with scarce elephant detections in experimental sites. This confirms the efficiency of populated colonies on deterring elephants (Ngama et al., 2016). Yet, more precision is needed to accurately connect the deterrence ability to the three colony growth steps, specifically founding, ergonomic and reproductive stages (Smith et al. 2016). This will add more precision in appraising beehive strength and the impact of SHB.

To conclude, in contrary to our first prediction, sites with colonies suffering SHB parasitism did not have more elephant visits than sites with no parasites. However, our second prediction was right; less elephant detection were recorded in sites protected with colonies having queen cells as indicator of fitness. Thus, in the overall context of elephant crop raiding mitigation strategies, the presence of bee queen cells in colonies can be used as a visual appraisal to see if bee colonies have reached the right efficacy level to chase elephants. Interestingly, our results seem to show that bees can be used as elephant deterrents despite parasitism due to SHB. Yet, as the use of bee as a conservation strategy also involve honey production (Ngama et al., 2016; King et al., 2017), we need to pay attention to honey production under the constraints of SHB presence. We also urge NGOs who promote beekeeping as an effective conservation strategy to give targeted people adequate training in all aspects related to beekeeping, including managing pests such as SHB.

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ИСПОЛЬЗОВАНИЕ ФОТОЛОВУШЕК И ВИДЕОКАМЕР ДЛЯ ИССЛЕДОВАНИЯ ВЛИЯНИЯ ВРЕДИТЕЛЯ *AETHINA TUMIDA* НА РАЗМНОЖЕНИЕ МЕДОНОСНЫХ ПЧЕЛ (*APIS MELLIFERA ADANSONII*) И ИХ СПОСОБНОСТЬ СДЕРЖИВАТЬ АКТИВНОСТЬ СЛОНОВ (*LOXODONTA AFRICANA CYCLOTIS*) В ГАМБЕ (ГАБОН)

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Взаимодействие пчел и слонов является центром курьеза сохранения природы, поскольку было показано, что пчелы, будучи одними из самых маленьких домашних животных, могут сдерживать активность слонов, самых крупных наземных животных. Тем не менее, паразиты насекомых могут влиять на применение и активность пчел. Поскольку их активность имеет решающее значение для их способности отпугивания от слонов, в этом исследовании оценивалось влияние малого ульевого жука (*Aethina tumida*) на размножение пчел (*Apis mellifera adansonii*) и их способность сдерживать лесных слонов (*Loxodonta africana cyclotis*). В связи со сложностью исследования межвидовых взаимодействий мы использовали фотоловушки и цифровые видеокамеры для наблюдения активности пчел и их взаимодействия с лесными слонами в различных условиях заражения улей малым ульевым жуком – обыкновенным вредителем пчел. Наши результаты показывают, что маточные пчелиные ячейки являются хорошими визуальными показателями эффективности колоний для сдерживания лесных слонов. Приведены доказательства того, что малые ульевые жуки в равной степени присутствуют в больших и малых пчелиных колониях. Тем не менее, полученные результаты показывают, что паразитизм малого ульевого жука не вызывает беспокойства при использовании пчел в качестве сдерживающего фактора для слонов. По-видимому, пчелы *Apis mellifera adansonii* эффективно справляются с паразитизмом малого ульевого жука, который не оказывает существенного влияния на размножение пчел и их способность удерживать слонов на расстоянии. Также в этом исследовании впервые сообщается о наличии *Aethina tumida* в качестве постоянного вредителя пчелиных ульев, который является проблемой, требующей решения в Габоне.

Ключевые слова: *Aethina tumida*, Габон, медоносные пчелы, слоны, фотоловушка