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LARGE-SCALE BIOTIC SURVEY IN MITARAKA, FRENCH GUIANA

Edited by Julien TOUROULT

Overview of Mitaraka survey: research frame, study site and field protocols

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Couverture / *Cover* :
Aerial view of Chukuchipann, inselberg located near the study area in the Mitaraka massif (photo: Xavier Desmier). In medallion: capture of a female *Panoploscelis scudderi* Beier, 1950 (Insecta, Orthoptera, Tettigoniidae) (photo: Xavier Desmier).

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ABSTRACT
This article introduces the biodiversity survey "Our Planet Reviewed" in the south of French Guiana organized in February-March and August 2015. It has enabled more than 50 scientists to inventory the following groups: Actinopterygii, Amphibia, Annelida, Arachnida, Insecta, Mollusca and Squamata, with a particular effort on diverse and little-known orders, such as Coleoptera, Diptera, Hemiptera and Hymenoptera. The forested area under investigation presents a mosaic of hills and inselbergs, with a wide variety of ecosystems. The main objectives were to discover new species for science, report first records for French Guiana, and establish a baseline inventory for biogeographic studies. The organisation of the field trip and post-field phase are supported by coordinators of major taxonomic groups. Authorisations and associated commitments, including Access and Benefit Sharing (ABS) are specified. The sampling effort, in terms of number and diversity of methods, is certainly the largest ever made in French Guiana over a short period of time. Thirteen different trap types were used including four types of interception traps and nine types of attraction-based traps. Active research methods (13 techniques) and extraction from the substrate (five techniques, including Winkler sieves, emergence from dead wood, etc.) completed the sampling array. The sample processing procedure describes the difference between active collecting and the longer and more complex

KEY WORDS
Tumuc Humac,
Guiana Shield,
Amazonian forest,
ATBI,
sampling strategy,
collecting methods,
taxonomic impediment,
invertebrates,
inventory.

process of processing massive samples of traps such as window pane flight intercept traps, Malaise traps, colored pan traps and automatic light traps. After a sorting phase that lasted less than a year for most groups, a network of 165 taxonomic experts was mobilized by the coordinators to study the sorted specimens. The data are stored and managed in an observations database and in the database of the collections of the Muséum national d'Histoire naturelle (Paris). Data are widely disseminated, notably in France via the Inventaire national du Patrimoine naturel (INPN) and internationally by the Global Biodiversity Information Facility (GBIF). This introductory article will be supplemented by a second paper, which will analyse research results three years after the survey and assess the effectiveness of the expedition in advancing taxonomic knowledge.

MOTS CLÉS
Tumuc Humac,
plateau des Guyanes,
forêt amazonienne,
ATBI,
stratégie d'échantillonnage,
méthodes de collecte,
handicap taxinomique,
invertébrés,
inventaire.

RÉSUMÉ
L'expédition naturaliste au Mitaraka : présentation des objectifs d'étude, du site et des protocoles.
Cet article présente l'expédition naturaliste « La Planète Revisitée » organisée dans le sud de la Guyane en février-mars et août 2015. Elle a permis à plus de cinquante scientifiques d'inventorier les groupes suivants : Actinopterygii, Amphibia, Annelida, Arachnida, Insecta, Mollusca et Squamata, avec un effort particulier sur les ordres à la fois riches et méconnus, comme les Coléoptères, Diptères, Hémiptères et Hyménoptères. La zone forestière étudiée présente un relief de collines et inselbergs, avec une grande variété de milieux. Les objectifs principaux étaient de découvrir des nouvelles espèces pour la science, d'établir de nouvelles signalisations pour la Guyane et de dresser un inventaire de référence pour les études de biogéographie. L'organisation de la mission et les phases post-terrain s'appuient sur des coordinateurs par grands groupes taxonomiques. Les autorisations et engagements associés, notamment l'APA (Accès et partage des avantages) sont précisés. L'effort de collecte, en quantité et en diversité de méthodes, est certainement le plus important jamais déployé en Guyane sur une courte période. Treize types de pièges différents ont été utilisés : quatre types de pièges à interception et neuf types de pièges fondés sur l'attraction. Des méthodes de recherche active (13 techniques) et d'extraction à partir du substrat (cinq techniques, dont les tamis Winkler et la mise en émergence de bois mort) ont complété l'échantillonnage. Le processus de traitement des échantillons est décrit en montrant la différence entre les collectes actives et le traitement plus long et complexe des échantillons des pièges massifs comme les pièges vitres, les Malaise, les assiettes colorées et les pièges lumineux automatiques. Après une phase de tri qui a duré moins d'un an pour la plupart des groupes, un réseau de 165 taxonomistes a été mobilisé par les coordinateurs pour l'étude des échantillons. Les données sont gérées dans une base de données d'observation et dans la base de données des collections du Muséum national d'Histoire naturelle (Paris). Elles sont largement diffusées, notamment en France via l'INPN (Inventaire national du Patrimoine naturel) et au niveau international par le GBIF (Global Biodiversity Information Facility). Cet article introductif sera complété par un second qui analysera les premiers résultats après trois ans de dépouillement et discutera l'efficacité de l'expédition pour la progression des connaissances taxonomiques.

INTRODUCTION

Over the past 30 years, scientists have become fully aware of the immensity of biodiversity. There are probably between five and 10 million eukaryotic species awaiting to be discovered today (i.e., Mora *et al.* 2011). It has been estimated that a quarter or even half of these species could disappear by the middle or the end of the present century (Régnier *et al.* 2015). The stakes of gathering knowledge before it is too late are therefore high and require, more than ever before, a new pace of exploration and disclosure of biodiversity (Bouchet *et al.* 2009).

The Muséum national d'Histoire naturelle (MNHN, Paris, France) and Pro-Natura International NGO (France) launched "Our Planet Reviewed", a major nature exploration program that aims at acquiring new knowledge on the world's most biodiverse but hitherto poorly explored regions for the main groups of organisms involved in the program: marine and terrestrial invertebrates. This "neglected" biodiversity (mainly non vertebrates together with fungi) represents 95% of the extant biota on this planet and plays a fundamental role in the equilibrium of ecosystems (Bouchet *et al.* 2009; Mora *et al.* 2011).

Typically, "Our Planet Reviewed" expeditions take only a couple of weeks to months at one single location with many researchers involved (more than 20 for field work). This approach allows mobilizing major logistical and human resources (expertise) on a wide diversity of species groups. The added outreach dimension of these operations, including the educational component supported by research activities and the wide media coverage, make the "Our Planet Reviewed" program quite unique. The number and diversity of participants ensure extensive research output and the data gathered feed large international databases.

After Vanuatu (2006), Mozambique and Madagascar (2009-2010) and Papua New Guinea (2012-2014), "Our Planet Reviewed" operated in French Guiana in 2014 (marine part of the expedition) and 2015, the first time in a French overseas region.

For French Guiana, such an expedition allows the country to benefit from international expertise on its natural heritage and to provide a national and international outreach. It is also an opportunity to raise local awareness of the extent and importance of this still poorly-known biodiversity. Together with local demand for more knowledge on biodiversity, increasing the inventory of French natural heritage was one of the main reasons for this choice. Since 2003, the MNHN has managed the Inventaire national du Patrimoine naturel (http://inpn.mnhn.fr), a reference programme on the taxonomy and distribution of French species, ecosystems and nature conservation.

As with the all taxa biodiversity inventory of the Mercantour National Park (Daugeron *et al.* 2015) and the Santo expedition (Bouchet *et al.* 2009), the numerous results make it possible to dedicate a thematic issue of *Zoosystema* to this expedition dedicated to the terrestrial results of the "Our Planet Reviewed" expedition in the Mitaraka Mountain range. In this opening paper, we present the study area and the objectives pursued as well as the implemented collecting techniques and protocols. Finally, we raise the issues of methodology and effectiveness linked to the concept of a natural history expedition, which will be analysed and discussed in a second article.

THE OBJECTIVES OF THE EXPEDITION "OUR PLANET REVIEWED" IN THE MITARAKA RANGE

"Our Planet Reviewed" expeditions are part of the generalized biodiversity inventory approach, often referred to as "ATBI" i.e. All Taxa Biodiversity Inventory. ATBI's differ in many aspects (Leponce *et al.* 2010): the duration of the project, the size of the territory studied, the number of participants in the field, the diversity of the taxonomic groups inventoried, the sample processing and the scientific scope of the results (inventory completeness baseline, new species discovery, macro-ecological research…). The Mitaraka expedition had a short duration and focused more on new species discovery rather than on inventory completeness.

The aims of the Mitaraka inventory were multiple and can be summarized by the following scientific objectives listed in relative order of priority: 1) To discover species new for science and to describe them in a short time frame; 2) to discover and publish first records (species known in other countries but not yet reported from French Guiana in the literature) for the French Guianian territory; 3) to update the national (MNHN) and regional reference collections with fresh material; 4) to develop an inventory as complete as possible in a remote site of French Guiana in order to serve as a reference for biogeographical studies and conservation strategies at the scale of the Guyana Shield and, possibly, for the whole Amazonian basin; 5) to manage and share these data with conservation managers and the scientific community within the framework of the INPN and the Global Biodiversity Information Facility (GBIF: https://www.gbif.org/) at the international level; and 6) to allow specific research by a few teams of researchers within the framework of ecological study protocols, the Habitats protocol (managed by the Guiana National Park and National Forest Agency), DynForDiv protocol (IRD) and Diadema protocol (LabEx CEBA) to study the link between species communities and forest habitats. This aspect will not be treated further here. Only the taxonomic processing and results of these protocols will be discussed below.

Other, secondary, objectives of the expedition, which were left to the participants' discretion and inspiration, include comparing different collection methods, documenting observations by means of *in situ* photographs and/or sound recordings of the species found, publishing new biological observations and/or DNA sequencing of different species for integrative taxonomic approaches.

In contrast to the IBISCA project (Basset *et al.* 2007) or to the "Our Planet Reviewed" edition in Papua New Guinea (Leponce *et al.* 2016) but as in some ATBI (Deharveng *et al.* 2015), the ecological study of ecosystems (diversity, structure, functions, interactions…) was not a major goal in Mitaraka, apart from the application of Diadema and DynForDiv protocols on forest tree composition. This stems from the initial choice of funders and sponsors to support a project focused on taxonomic discovery, a type of naturalistic research that remains underrepresented and underappreciated in high-level research currently carried out on French Guiana's biodiversity. In addition to these scientific objectives, there was also a clear objective of communication on biodiversity, taxonomy and knowledge on living organisms among different audiences and stakeholders. This objective is reflected by the presence of journalists for a national coverage of the event, by the work organized with schools in French Guiana and by a public dissemination of the results.

STATE OF KNOWLEDGE ON FRENCH GUIANA SPECIES DIVERSITY AND FOCAL TAXA OF THE EXPEDITION

In 2014, a first primary inventory of French Guiana insect species compiled by the MNHN and the Société entomologique Antilles-Guyane (SEAG) was analysed in order to serve as a basis for the national taxonomic reference system TAXREF (Brûlé & Touroult 2014). The following was derived from this database of more than 15 100 valid species names cited from French Guiana in the scientific literature as of 2014 (in November 2017, the updated list had reached 16 620 species, Gargominy *et al.* 2017). On a global scale, between Carl von Linnaeus (1758) and 2013, the average rate of species descriptions reached about 60 species per year, with the highest peak during the early 20th century (178 species per year between 1904 and 1908). In the last century, 1960-1970 proved the least productive period. The most recent (analysis of the 2008-2013 period) overall rate of added species is much

higher than the average. It has reached about 180 species per year, with *c.* 100 new species to science and 80 first records for French Guiana.

Contrary to a widespread belief and an internationally documented phenomenon of decline in taxonomy knowledge (Hopkins & Freckleton 2002), knowledge on insect diversity has been progressing at a relatively high rate in the past 10 years in French Guiana due to combined efforts of some professional taxonomists and the large amateur community involved in collecting material and describing new species. Requests by protected areas managers for faunal surveys, have also offered new opportunities to obtain material from remote sites. However, the taxonomic inventory is far from complete and the current species number is estimated to be around 20% of the extant richness (Brûlé & Touroult 2014). Richness by taxonomic order in French Guiana was compared with that at the global level (Zhang 2013). Five insect groups appeared to be relatively better studied (and/or possibly more diverse) in French Guiana, compared to the global level: Odonata, Mantodea, Lepidoptera, Blattodea, and to a lesser extent, Dermaptera. Phasmatodea, Coleoptera, Orthoptera and Megaloptera were at a comparable level between French Guiana and the global level. It should be noted that the known richness of the orders in these two categories is still far from being exhaustive, even including Lepidoptera and Odonata. The other 20 orders are underrepresented in the faunal list of French Guiana in comparison to the world level status. They might be either less diverse in French Guiana for large scale biogeographical reasons, or perhaps they have not received as much attention as other taxa. The current steep rate of descriptions in some of these groups (Hymenoptera, Hemiptera) seems to support the second hypothesis. The highly diverse orders, which are obviously understudied in French Guiana, offer the largest opportunity for extensive taxonomic discoveries, and first country records. The first four insect orders are: Diptera, Hymenoptera, Hemiptera and Trichoptera. Although seemingly equally represented in both French Guiana and the world, the megadiverse Coleoptera is certainly, in absolute numbers, one of the orders with most species to be described (Touroult *et al.* 2014).

In an annotated list of the 453 species of French Guiana spiders, Vedel *et al.* (2013) also highlighted a very low level of taxonomic knowledge on this speciose group.

In view of the above mentioned recent assessment of knowledge, the Mitaraka survey and the whole process of studying the collected material had to focus mainly on Diptera, Hymenoptera, Hemiptera and Coleoptera, as far as insects were concerned, and also to treat other invertebrates, such as Arachnids and Annelida. However, knowing that there are also species to be discovered in the better known classes and orders (such as Lepidoptera, Odonata and even herpetofauna and fish) and with the aim of drawing up a reference inventory for this area, a broad taxonomic scope was maintained. Mammals and birds were deliberately not included, although participants were encouraged to list their occasional observations in the Mitaraka survey database.

In conclusion, the following major animal taxa were surveyed: Actinopterygii, Amphibia, Annelida, Arachnida, Insecta and Squammata.

SELECTION OF THE STUDY SITE AND PRESENTATION OF THE SURVEY AREA

French Guiana is a territory of 84 000 km^2 in northern South America. It belongs to the Guianan moist forest ecoregion (Dinerstein *et al.* 1995), and is covered by a relatively homogeneous lowland tropical rain forest for about 95% (Guitet *et al.* 2013). It does not belong to a biodiversity hotspot as defined by Myers *et al.* (2000) because it is not an area with a strong level of endemism nor one that encompasses severely threatened ecosystems. Nevertheless, due to its high preserved forest coverage rate it is recognized as part of the 24 wilderness areas in the world as defined by Mittermeier *et al.* (2003).

Paradoxically, French Guiana is very well studied compared to other neotropical territories. With the purpose of discovering new species, the expedition could have been conducted in practically any forested area of French Guiana, even in fragile and little known ecosystems like savannahs or coastal marshes. It would have sufficed to sample poorly known taxonomic groups and to mobilize a network of taxonomists. However, an expedition such as "Our Planet Reviewed" is a broader concept that aims also to raise awareness of the Linnean shortfall and promote a positive image of biodiversity and its exploration. Moreover, an expedition like this does not seek to compete with the routine work by researchers and naturalists working in French Guiana.

Study area and sampling period

The choice of the area was the result of a discussion between naturalists specialized in French Guiana and takes into account a series of biogeographical, practical and strategic criteria. The area had to meet the following requirements:

1) very little studied so far, and not to be reached by usual transportation (over land or water); 2) with varied topography, which guarantees a diversity of natural environments, themselves inducing a high species diversity; 3) remote, i.e., far from the well-studied areas in entomology and botany, because following the "distance-decay" of compositional similarity theory, the farther away one gets, the greater the change in species composition (Nekola & White 1999); this criteria also encompasses the presence of a different landform type (Guitet *et al.* 2013) which in turn translates into different habitat types and forest tree compositions (Guitet *et al.* 2015a) probably influencing the entire food chain composition; 4) sufficiently accessible for a first exploration and for camp installation, which in French Guiana forest implies the presence of a natural open area (for example flat rocky outcrop); 5) without risk to human safety, e.g. not in an area with illegal gold mining that drives insecurity and risk of diseases; and 6) in a grandiose landscape (e.g. inselbergs), to convey a positive message and thus raise awareness of the challenge of discovering biodiversity.

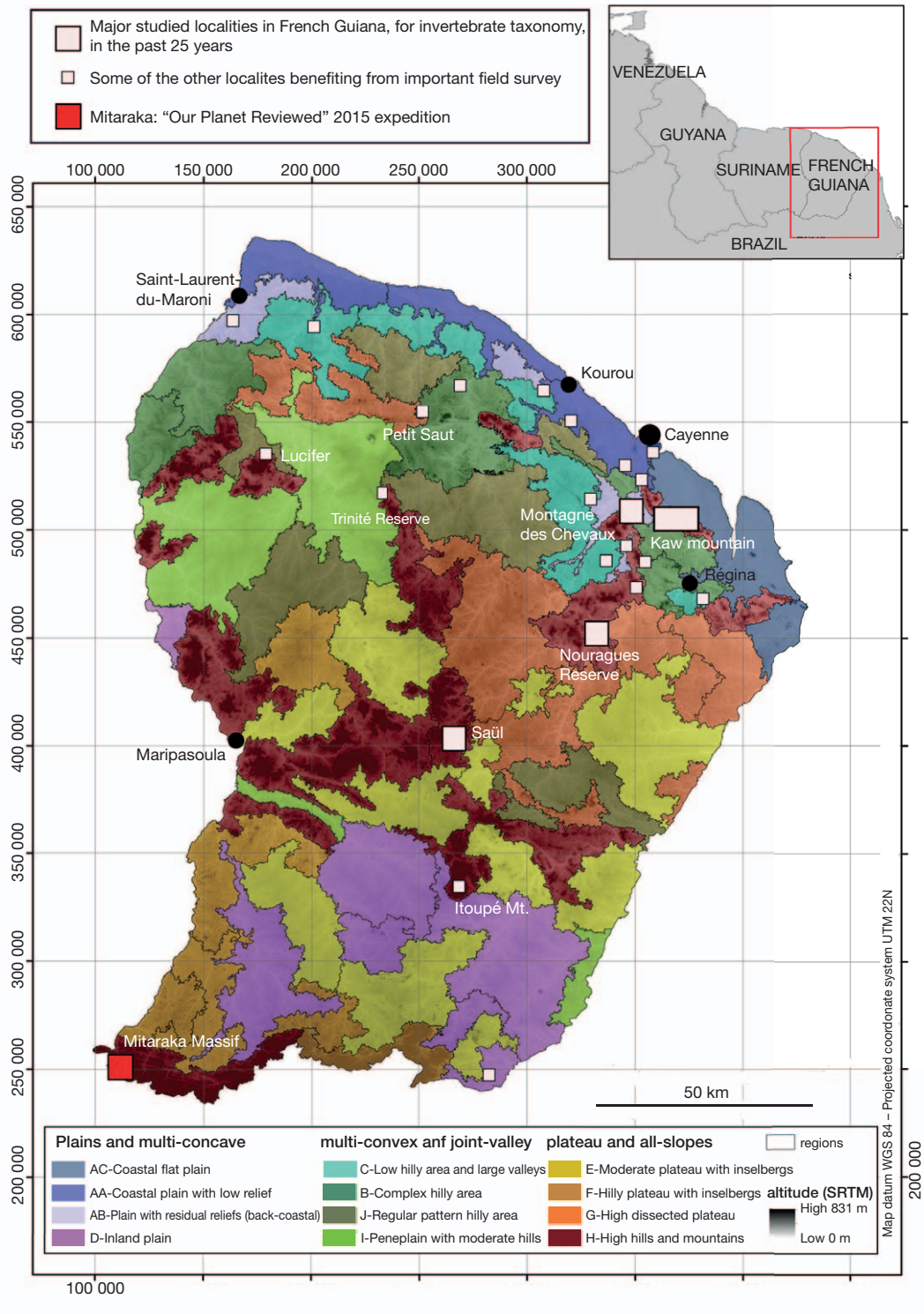

Fig. 1. — Position of the study area (red square) on a map of landscapes of French Guiana (modified from Guitet *et al.* 2013) and compared to other sites (indicated by white squares and rectangles) that have benefited from important survey efforts on invertebrates in the last 25 years (two categories, based on number of collectors, duration of studies, trap types involved and number of published new species).

By combining all of these criteria, relatively few candidate sites were left. Coastal sites were excluded because they could be studied by local teams without the need for "expedition" logistics, as well as interior sites such as Mount Itoupé or Saül, which were considered as already well-studied by the Amazonian Park and research teams. Montagne de Kaw, Montagne des Chevaux, Réserve des Nouragues and Saül were considered as the best studied sites in French Guiana, from an expert assessment made from collecting methods used and new species descriptions (Fig. 1). Therefore, Mitaraka soon

emerged as one of the most remote and ecologically complementary locations compared to sites already benefiting from taxonomic knowledge.

The rainy season in French Guiana is generally not the most favourable period for collecting many Coleoptera and Lepidoptera, which diversity is better studied during the transition seasons (August/September and December/January). However, there is still a lack of data on the seasonality of many groups in French Guiana, the available references only concern the northern part of the department and the available data show peaks in activity which vary according to the taxa studied (see some synthesis in Degallier *et al.* 2004, and Touroult *et al.* 2017). Due to logistical, budgetary, and issues related to the availability of local experts, the optimal study period (August or December) could not be chosen and the expedition eventually took place in February and March.

In order to take advantage of the existing facilities and infrastructure (e.g. drop zone, base camp, trails, etc.) and to maximize sampling, a second field trip, shorter and smaller in size, and focusing on insects only, was conducted at the beginning of the dry season (August 2015).

Landscape, habitats and site description

The expedition was conducted in the Mitaraka Mountains, a largely unknown and currently uninhabited area in the extreme south-western corner of French Guiana (Fig. 1). It is part of the Tumuc Humac mountain chain, extending east in the Amapá region of Brazil and west in southern Surinam. The area consists primarily of lowland tropical rain forest with scattered inselbergs, isolated granitic rocky outcrops that stand above the forest cover. The landscape type can be described as "high hills and mountains" according to the Guitet *et al.* (2013) classification. The entire area is situated in the core of the protected Parc Amazonien de Guyane. The base camp was located near the Alama river, at coordinates 2°14'1.9"N, 54°27'38.1"W at an altitude of about 310 m a.s.l. Administratively, the whole study area belongs to the commune territory of Maripasoula, the largest French Guianan district. Four forests tracks of about 3.5 km were mapped out in four different directions starting from the camp and were the main gateways to the collecting sites (Fig. 2). Other tracks opened for the project led to the "Sommet-en-Cloche", an inselberg near the base camp, and to the more distant Borne 1 inselberg, a rocky outcrop that marks the western border between French Guiana and Brazil (Fig. 2). The highest points in the area peak at 580 m to 690 m (Mount Mitaraka, the Tchoukoutchipann, Sommet-en-Cloche, and Borne 1).

From a more detailed botanical perspective, according to the Mitaraka botanists' team (D. Sabatier & J.-F. Molino, pers. comm.), a high alpha (local), beta (turnover) and gamma (regional) species diversity are an important characteristic of the tree communities of the Mitaraka area. They correspond to a species richness around 200 tree species per hectare of forest, or more, comparable to the highest diversity estimates obtained in central and northern French Guiana, and much higher than those obtained in the southern peneplain and Mont Itoupé (Centre-Sud). The Mitaraka tree composition surprisingly shares some common particularities with forests from the north, especially the abundance of a group of structuring species such as *Astrocaryum sciophilum* (Miq.) Pulle (Arecaceae), and several Caesalpinoideae as *Vouacapoua americana* Aubl., *Dicorynia guianensis* Amshoff and *Eperua falcata* Aubl. However, it is distinguished by a lower diversity of Chrysobalanaceae (*Licania* Aubl. 1775 in particular) and Lecythidaceae (*Eschweilera* Mart. ex DC., 1828 in particular), by the presence of numerous species of Amazonian affinity and of the western Guiana shield, at the limit of their range (*Bocageopsis multiflora* (Mart.) R.E.Fr., *Toulicia elliptica* Radlk., *Vochysia glaberrima* Warm., *Cedrela fissilis* Vell., etc.), and by a low number of eastern Guianian endemics. The most marked originalities are due to species associated with transition forests to rock-savannah (edaphic specialisation) as well as to species with an Amazonian affinity at the limit of their distribution range.

A second major characteristic is the great diversity of forest landscapes and associated communities (Fig. 3). The forest is discontinuous (cambrouses openings) and the dynamic (turnover) of the forest cover seems high given the abundance of vines and clearings. This might be due to the combination of a prolonged human presence – which was interrupted only in recent history (Wayana territory, Marie Fleury pers. comm.) – and a diversity of edaphic conditions resulting from rocky outcrops and soils of varying depths.

The main natural environments in Mitaraka are the following, based on the guides to habitats in French Guiana (Granville 2002, Guitet *et al.* 2015b):

- a dense forest of medium altitude "mountains" (in the sense of French Guiana, hills from 100 to 500 m) with Mimosoideae and Burseraceae, in a relative dry context estimated at 2.200 to 2.600 mm of annual rainfall (compared to for instance, more than 4.000 mm in the northeastern part of French Guiana); this habitat, which is the main habitat in the area, can itself be divided into a slope areas ('pentes'), plateaus and in hill tops;
- forests of transitions on the edge of inselbergs and forests on inselbergs, which are characterized by lower canopy and by a high density of lianas;
- bare rock slabs called "savanes roches", sometimes covered with herbaceous vegetation (*Pitcairnia* sp., Bromeliaceae);
- "cambrou(s)ses", a facies made up of open grassy areas with bamboo (*Guadua macrostachya* Rupr.) where forest dynamics are blocked for a variable period of time;
- swamp forest with palm, called "pinotière" or "bas-fond", with a species of palm tree, *Euterpe oleracea* Mart., almost monospecific in the tree-lined stratum;
- headwater rivers, close to springs and with a flow strongly depending on the season.

The inselbergs, from German 'Insel' = island and 'Berg' = mountain, are isolated rocky outcrops consisting generally of Precambrian granite or gneiss. They have been rather well studied in French Guiana and are known to host

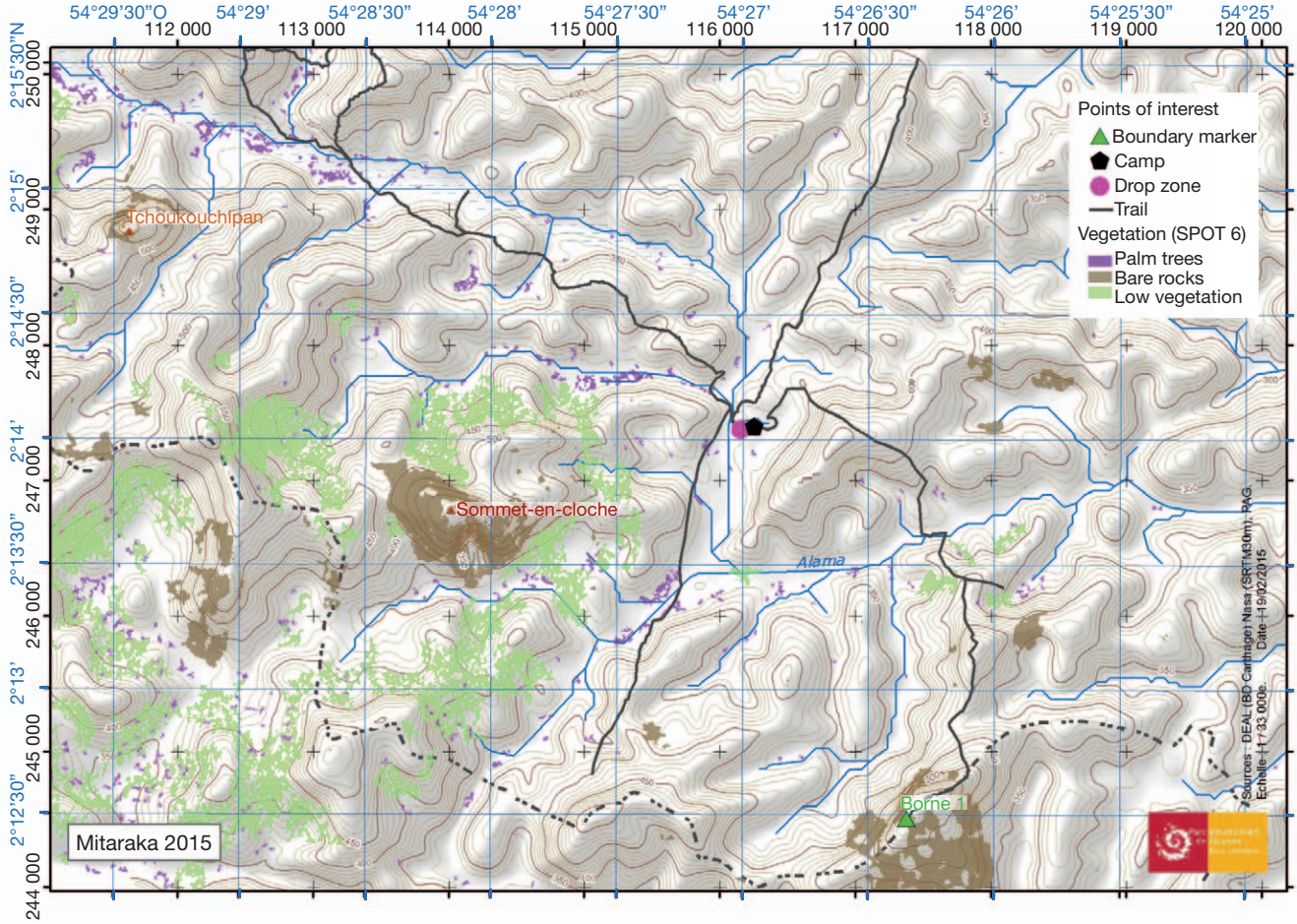

Fig. 2. — Mitaraka study area map with the four trails indicated (map by Maël Dewynter, map base by IGN and Parc amazonien de Guyane).

a particular biodiversity, sheltering naturally fragmented populations and including a flora adapted to xeric conditions (Sarthou *et al.* 2003). Inselberg regions of the Guiana shield, like Mitaraka, are still debated as possible palaeoclimate refugia and endemic centres (Lourenço 2016). For plants, Sarthou *et al.* (2017) showed that northern inselbergs, located in wetter context, harbour more endemics than those of southern French Guiana.

The presence and configuration of the artificial forest clearing (approximately 1000 m^2) represented by the drop zone (created to allow a helicopter to land, and cut just one month before the field trip), appeared to be a very favourable habitat for saproxylic species and forest gap specialist species. Its position near the base camp was also an asset to quickly raise and remove traps and search actively for insects.

History of naturalist' prospection in the Mitaraka range

The study area was not pristine of previous naturalistic surveys. Information was found on the following field trips: a field trip in the 1970s, dealing with botany and herpetofauna (J.-J. de Granville, J.-P. Gasc); field trips in 2001 and 2002 as part of the prefiguration field trip of the National Park with some MNHN specialists in botany, herpetology and fish as well as soil fauna and entomology; in October-November 2004 and September 2006, the Alabama association carried out a field trip on Borne 1 and South Mitaraka (border with Brazil) with a few scientists including entomologists.

Far from being negligible, however, these surveys never counted more than two entomologists for a few days, and the collection techniques were focused on light trapping and visual search, all useful but insufficient to properly document the invertebrate diversity.

Searching publications that deal with results from these surveys in the Zoological Record index, completed with network search, produced only five papers on invertebrate taxa: Gantier *et al.* (2006) on phlebotomes (Diptera: Psychodidae), Bérenger & Blanchet (2007) on Reduviidae bugs, Chassain (2010) on a new click beetle species (Coleoptera: Elateridae), Dechambre (2008) on a new Dynastinae beetle, and a description of a scorpion based on material from the 2001 field trip (Lourenço 2016).

Slightly more publications are available on botany, especially inselberg flora, on herpetofauna and freshwater fishes but overall the biodiversity of the area remained poorly documented until present with, for instance, just 160 species mentioned in the inventory of important ecological areas (https://inpn.mnhn.fr/zone/znieff/030120062/tab/especes).

GENERAL ORGANISATION, PLANNING AND TEAM COMPOSITION

For each of its operations, "Our Planet Reviewed" attempts to assemble a group of highly qualified specialists that preferably cover a wide array of taxa selected beforehand, both for field work and post-survey processing of samples and collected specimens. A key partnership has been established with a dynamic local entomological association, the Société entomologique Antilles-Guyane (SEAG). This facilitated the organisation through advice on the best collecting and rearing methods for insects in French Guiana, by providing equipment, sorting part of the yields and sharing its repertoire of specialists.

Team composition and expert network

During the preparation of the field phase, the core coordination team (J. Touroult and O. Pascal with the assistance of M. Leponce, P.-H. Dalens, J. Orivel and C. Baraloto) selected the participants and sought coordinators for the main taxonomic groups. In the scientific field, three key players can be identified for success in the whole process: field workers, coordinators for the management and valorisation of specimens, and taxonomic experts, who are specialists in a group (family or sub-family in general for invertebrates). Each of these actors signed a field trip commitment (see Appendices 2, 3 and 4), which sets out rules for traceability, feedback and sample sharing. In some cases, one single person fulfilled all three roles.

The field workers were selected according to their taxonomic specialty and/or expertise in setting up trapping devices and working in neotropical forest conditions. The list of participants is added in Appendix (S1).

The coordinators defined the network of taxonomic experts to process/identify the collected material, were responsible for and/or followed up the sorting of the material, and monitored research outputs generated by the network members (incl. submission of completed identification lists). Most of the following coordinators actually participated to the fieldwork: Jérôme Barbut (Lepidoptera, Heterocera), Sébastien Brosse (freshwater fish), Thibaud Decaëns (Annelida), Laure Desutter (Orthoptera), Gunther Fleck (Odonata and other aquatic insects), Antoine Fouquet (Amphibia), Olivier Gargominy (terrestrial Gastropoda), Eric Guilbert (Hemiptera), Frédéric Legendre (Blattodea *sensu lato*), Jérôme Murienne (Opiliones), Antoine Mantilleri and Julien Touroult (Coleoptera), Marc Pollet (Diptera), Eddy Poirier (Rhopalocera), Tony Robillard (Phasmatodea and Dermaptera), Vincent Vedel (Araneae), Nicolas Vidal (Squamata), and Claire Villemant (Hymenoptera).

Thanks to these coordinators, about 165 taxonomic experts were contacted prior to the mission and declared a commitment to examine the samples. This list is partly based on the operational network set up by SEAG to study the samples collected during its inventory missions, but it was also largely completed on less studied groups such as the Hymenoptera (23 specialists), Diptera (31 specialists, updated at 36 after the field survey, 33 of whom received samples) and Hemiptera (13 specialists). These experts agreed to examine and identify the specimens they received, to send a list with the identification results (template available) to the group coordinator, describe as many new taxa as possible, deposit the holotype and 50% +1 of the paratypes (new species) and a representative sample of specimens (described species) at the MNHN. In a few cases e.g. Diptera, there was an additional level of sorting, done by a taxonomic coordinator/expert who partly split processed samples into workable fractions (e.g. subfamilies, tribe or genera) and disseminated these to (other) taxonomic experts.

Fieldwork

During the Mitaraka field survey, forty-six researchers and a support team of about a dozen people (medical doctors, a camp manager, cooks, etc.) took part in the operation between 23.II and 27.III.2015. Prior to this implementation phase, three field trips had been required: 1) to locate the base camp site and open a helicopter landing zone with the support of the French army 9th RIMa (14-21.I); 2) to open a network of "layons" (trails) and to describe habitat types with the assistance of the Office national des forêts (ONF) and the Parc amazonien de Guyane (PAG) (21-30.I); and 3) to construct and develop the base camp (9-22.II). A total of 75 people contributed directly to the field operation for its establishment and implementation. Another field trip (11-21.VIII) in the same area brought together ten entomologists, led by SEAG to conduct insect collections during the dry season.

Collection and access permits

The National Park scientific council was consulted and advised positively on the scientific program of the expedition (Decision No. 343-15) while recommending a stronger integration of ecological study programs.

The project also needed the approval of an ABS (Access and Benefit Sharing) agreement between the MNHN and the Region. Following the requirements of the Nagoya Protocol, this agreement determines what can be done with samples (taxonomic research including DNA barcoding, but no bioprospecting) and organises the restitution and sharing of results between contractors. This was the first convention of this kind in French Guiana. The clauses of this ABS agreement are based on current good practices already applied for this type of naturalist expeditions: regular transmission of publications and data, return of a representative sample of collected taxa to the upcoming regional collection, and traceability of specimens transfer. All specimens are therefore labelled "APA 973-1".

The organizers invited the field workers, coordinators and taxonomic experts to sign and respect a standard agreement, dealing in particular with the timely treatment of the samples, the return of a fair share of the material to the MNHN, and the sharing of material by the taxonomic expert. They also provided standard references to the "Our Planet Reviewed" expedition, funders, authorisations and ABS traceability that should be used for specimens labelling and/or for scientific papers.

Fig. 3. — Illustration of the landscape and main habitat types found in the Mitaraka study area: **A**, general landscape of the study area, with the drop zone visible in the foreground; **B**, inselberg "Sommet-en-Cloche" with bare rocks and transition forest; **C**, mosaic of forests and cambrouses; **D**, forest interior; **E**, swamp forest (bas-fond) with *Euterpe oleracea* Mart palm. Photos: Xavier Desmier, except B, Stéphane Brûlé.

Table 1. — Summary of sampling techniques used: passive sampling and intercept traps. Traps were operational during the full survey unless otherwise mentioned. Caption: **NA**, not applicable; **OEP**, oriented expert positioning, with traps installed in the most favorable situations, without pre-determined sampling plan; **SRA**, stratified representative approach, involving pre-determined plots selected and sampled according to a strict sampling protocol.

Sampling techniques (code used)	Short description	Illustration	II-III.2015	VIII.2015	Sampling strategy, trap positioning	Targeted taxa
Flight intercept trap (FIT)	Large windowpane plastic (plexiglass) plate of 1 × 1.5 m, suspended over a gutter filled with salted and surfacted water (see Lamarre *et al.* 2012 for more details)	Fig. 5A	13 traps	NA	OEP: installed on different dead trees during the first 15 days on the drop zone SRA: afterwards 8 traps included in the Diadema protocol: 4 traps in each plot, with two on the forest floor, and two in the canopy, in operation during 48 hours. Total yield = 36 samples	All insects that fall into the gutter after hitting the vertical plastic plate. Very effective for Coleoptera and Blattodea, less so for Hymenoptera and Diptera compared to Malaise (Lamarre *et al.* 2012)
Malaise trap (MT)	Large elongate model of 6 m long, with a collecting jar at each side of the trap	Fig. 5B	2 traps	2 traps	OEP: on large fallen trees, in clearings and along corridors	All flying insect that crawl/ fly up after encountering the vertical wall. Very effectivefor Hymenoptera, Diptera and some Coleoptera
Sea and Land Air Malaise (SLAM)	Particular cross bidirectional (square) Malaise trap of 1.5 m diameter	Fig. 4A, B, C	33 traps	20 traps	OEP: 90 % (n=46) of the traps installed on top of dead wood (logs) in clearings (drop zone), 3 traps in the nearby forested area, 1 on Borne 1 inselberg, and 3 on transitional forest on the Sommet-en-Cloche inselberg	Similar to Malaise trap (see above)
Artificial Spider Web (ASW)	Also called "cryldé", looks like a synthetic spider web (Halloween supply) that can be spread over tree branches and shrubs	Figs 4B, 5D	2 kg = about 60 × 1.5 m spread	NA	OEP: attached to logs and around dead standing trees	Mostly large Coleoptera. Low efficiency but interesting to collect live specimens (for photography) of rarely encountered species
Unbaited Pitfall trap (PF)	Jar with 6 cm diameter, and depth of 10 cm, ⅓ filled with a soapy salty water, dug into the soil with the upper rim at soil surface level	–	180 traps	NA	SRA: part of Diadema stratified sampling, with 20 traps installed in each of 9 plots, and operational during 72 hours	Used for soil-dwelling invertebrates, i.e., Formicidae (Hymenoptera) and spiders (Araneae)

INVENTORY PROTOCOLS

Collection methods

Numerous collecting techniques were used, either group-specific or broad-spectrum (Figs 4-8). They can be classified into the following categories (Nageleisen & Bouget 2009): 1) interception traps: passive, interceptive approaches that depend on the active movement of (flying) insects (Table 1); 2) attractive traps: trapping approaches with a source of attraction (light, color), which generally target one or a few taxonomic groups (Table 2); 3) sampling of a substrate which implies the extraction of specimens from this substrate (Table 3) and 4) active collecting: active searching for individuals in the field, e.g. with collecting equipment like a sweep net, or by listening to the sound made by animals (Table 4). Note that some methods may fall in two categories: beating vegetation is an active method that samples a part of the substrate (vegetation).

Overall, 13 different trap types were used (including four variants such as pan trap color or automatic light trap lamp type, Polytrap ™) and about 18 active search and substrate sampling techniques (Tables 3, 4).

In addition to this methodological diversity, the quantity of traps that were in operation simultaneously was the most extensive use of collecting devices reported in French Guiana. For example, there were 35 Malaise traps (33 Sea and Land Air Malaise (SLAM) traps and two 6 m long Malaise traps) operational for one month, and nearly 280 pan traps for 14 days.

These methods cover all strata and the majority of functional invertebrate groups, with probably a particular emphasis on saproxylic species, due to the presence of several specialists. There was no intensive canopy sampling effort but the automatic light traps, nymphalid traps and fruit traps were placed within the canopy using a Big Shot (Fig. 6H). Under

TABLE 2. — Summary of sampling techniques used: attraction traps. Traps were operational during the full survey, unless otherwise mentioned. Caption: **NA**, not applicable; **OEP**, oriented expert positioning, with traps installed in the most favorable situations, without pre-determined sampling plan; **SRA**, stratified representative approach, involving pre-determined plots selected and sampled according to a strict sampling protocol.

Sampling techniques (code used)	Short description	Illustration	II-III.2015	VIII.2015	Sampling strategy, trap position	Targeted taxa
Automatic light traps (PVB, PVP, PGL)	Combination of a cross FIT (PolytrapTM) with a small light source (PVB = blue LED 20000K; PVP = pink LED and PGL = Gemlight® with one UV LED and one green LED), powered by a car battery and operational for up to 8 successive nights. With a collector jar filled with salted monopropylene glycol (see Dalens & Touroult 2014)	Figs 4B, 6A	12 traps (4 PVB, 4 PVP, 4 PGL) operated for 28 nights	9 traps (3 PVB, 3 PVP, PGL) operated for 10 nights	OEP: suspended in clearings at a height, ranging from 2 m to 20 m in canopy	Nocturnal flying insects, mainly Hemiptera, Coleoptera, Orthoptera, Isoptera. Not relevant for moths due to liquid jar. Each light source attracts a rather different combination of species
Light trap (LT)	Classic light trap including a white vertical sheet, with one MV 125 W lamp at each side, powered by a generator	Fig. 6B	1 trap each night + a few nights with a second trap (32 nights in total)	2 traps during 10 nights (= 20 nights)	OEP: installed in the drop zone (principal trap), and on inselbergs slopes (two supplementary traps)	Nocturnal flying insects, mainly Lepidoptera, Coleoptera, Hemiptera, and Orthoptera
Moth automatic light trap (ALT)	A cross flight intercept trap, with a small LED light (5 mm: Straw Hat Wide Angle UV Purple LED Ultra Bright, flat top UV LED and LED blue ocean UV) and a dry killing jar	–	36 traps (one night each)	NA	SRA: part of DIADEMA sampling protocol: 4 traps at each plot and operational during 24 hours	Mainly Lepidoptera, but also some Coleoptera and other insect orders
Pan trap (YPT, WPT, BPT)	Light-weight plastic bowls (diameter: 15 cm, depth: 4 cm) of different colors, filled with either formaline solution with detergent, or soapy salty water, installed at soil surface level (sometimes slightly dug in)	Fig. 6C	280 traps (110 blue, 70 white and 100 yellow) operational during 15 days	30 traps (white and pink, diam. 15 cm, depth: 2.5 cm)	SRA: II-III: semi-stratified approach: in three habitat types (hill top, slope, palm swamp) along trail A and C (incl. 2 DIADEMA plots along trail C), in forested area of drop zone and nearby palm swamps OEP: VIII: in forest gaps	Mostly Diptera and Hymenoptera but also other Arthropoda including Formicidae (Hymenoptera), Scarabaeidae, (Coleoptera), Blattodea, a.o.
Fruit baited trap (BT)	Bottle of 5 liters, with a lateral opening; filled with banana nectar and suspended in trees in sunny places	Fig. 6D	18 traps	8 traps	OEP: in sun-exposed trees near the base camp, at a height of 3 to 20 m	A few particular species of Coleoptera, mostly in Cerambycidae, Scarabaeidae and Histeridae
Nymphalidae butterfly trap (CHX or FT)	A cylinder of fine tissue (diameter: 30 cm, height: 80 cm) with a bottom tray containing bait. The trap is suspended on a cord in a tree. The butterflies enter through a gap between the tray and the tulle cylinder. As the butterfly normally flies upwards after feeding, it remains captured. The usual bait is banana fermented with alcohol. A smaller model of 25 cm by 50 cm with lateral opening was also used	Fig. 6E	30 traps, and 50 of the smaller model 8 traps (72 samples) from Diadema	22 traps; 2 additional traps were baited with dead fish	OEP: near base camp and in transition forest on inselberg, in sunny areas, suspended at 3-25 m height SRA: part of DIADEMA protocol: 4 traps in understorey and 4 traps in canopy in each site for 48 hours	Rhopalocera (Lepidoptera), mostly Nymphalidae
Coprophagous pitfall trap (PFC)	Pitfall (Barber) trap dug into the soil and baited with human dung	Fig. 6G	12 trapping days	18 trapping days	OEP: near the base camp	Scarabaeinae (Scarabaeidae, Coleoptera)
Ant sampling with arboreal baitlines	Baits made up of a mixture of tuna and honey, laid out on ropes at different heights (at 5 m intervals) between the canopy and the ground	Fig. 6F	30 trees sampled at two occasions	NA	SRA: applied in 2 DIADEMA plots (baiting during 4 hours)	Exclusively Formicidae (Hymenoptera)

Table 3. — Summary of sampling techniques used: active searching. Caption: **NA**, not applicable; **OEP**, oriented expert positioning, with traps installed in the most favorable situations, without pre-determined sampling plan; **SRA**, stratified representative approach, involving pre-determined plots selected and sampled according to a strict sampling protocol.

Sampling techniques (code used)	Short description	Illustration	II-III.2015	VIII.2015	Sampling strategy, trap position	Targeted taxa
Visual snail search	Search on sight during daytime on rocks, foliage, soil, tree trunks and logs	–	14 days (41 sites with snails)	NA	OEP: search in as many sites as possible, including favourable micro-habitats along the trails	Gastropoda
Visual snake search	Walking the trails very slowly during daytime and at night	Fig. 7F	14 days and nights	NA		Squamata (also used for Amphibia)
Fish field observations	Visual identification during diving in sites deep enough to make underwater observations	–	10 hours	NA	OEP: at sites deep enough to make underwater observations. The fish were photographed *in situ* for taxonomic confirmation. A night dive was conducted in the Alama to observe nocturnal species	Actinopterygii
Visual search of larvae	Search in rotten wood (Coleoptera) and on flowering lianas (Lepidoptera)	Fig. 7C	2 hours	5 hours	Oriented search in favourable micro-habitats	Lepidoptera, Coleoptera
Night active insect search	Looking for insects (Blattodea-Orthoptera-Coleoptera) in their preferred micro-habitats at night with headlamp	–	16 nights by 2 researchers (Blattodea, Orthoptera); 10 hours for Coleoptera.	5 hours (Coleoptera)	OEP: search in different vegetations (inselberg rock slabs, transition forest, swamp forest, slopes), in logs, and on wood fungus on/near the drop zone	Blattodea, Orthoptera, Phasmatodea, Coleoptera (saproxylic)
Night active Arachnida search	Active search of one hour on soil and one hour on trunks at night	–	18 h (2 h per habitat plot)	NA	SRA: part of DIADEMA protocol; on habitat plots	Araneae and Opiliones
Amphibians VES (Visual Encounter Survey) and AES (Acoustic Encounter Survey)	All amphibians detected by sight or calling, regardless of their distance from the observer, are registered in the inventory (by day and night). Not all specimens are collected	–	approx. 300 hours	NA	OEP: search in favourable habitats, along rivers or streams, near temporal ponds, on inselberg rock and in slope forests	Amphibia
Amphibians Standardized Visual Transect Sampling (SVTS) and Standardized Acoustic Transect Sampling (SATS)	Repeatedly (9 times: 3 schedules per day during 3 different days) browse transects (200 m long) taking into account only the individuals observed or discovered within 5 m at each side of the transect	–	9 plots (81 monitoring data sets)	NA	SRA: part of Diadema protocol; search in habitat plots	Amphibia
Fishing net and creel	Fish traps and net fishing by night and day	–	1 river section	NA	OEP: in the main course of the Alama River where rotenone is not useful	Actinopterygii
Net collecting by day (HC or SW)	Collections of mostly flying insects during the daytime with sweep net or butterfly net in favourable habitats and micro-habitats. Applied after visual observation	Fig. 7A	approx. 300 hours	Approx. 160 hours	OEP: in favourable habitats for the targeted taxa	Mainly Lepidoptera, Hymenoptera, Diptera, Odonata
Heavy Duty Aquatic Nets (TROU)	The larvae were captured using a 1 × 3 mm mesh or a 3 × 4 mm mesh	Fig. 7D	approx. 15 hours	NA	OEP: in favourable aquatic habitats	Odonata larvae, aquatic Hemiptera, Coleoptera
Random net sweeping (NS or SW)	Collection by applying sweep net (of 50 cm diameter) in forest understory (Araneae), or in grassy vegetation on inselbergs (beetles and other invertebrate orders). Applied at random	Fig. 7B	18 h (1 h by day, 1 h by night × 9 plots) for Diadema Araneae; approx. 10 h for beetle searching	approx. 20 h (beetles)	SRA: part of Diadema protocol; search in habitat plots (Araneae) OEP: search in favourable habitats (other invertebrates)	Araneae, Coleoptera, Hymenoptera, Diptera

Table 3. — Continuation.

Sampling techniques (code used)	Short description	Illustration	II-III.2015	VIII.2015	Sampling strategy, trap position	Targeted taxa
Beating vegetation (BS)	The vegetation (incl. dead branches) is beaten with a stick, which causes the Arthropoda to fall on the white nape mounted on a frame and held below the beaten vegetation (1 m² beating sheet)	Fig. 7C	18 h (1 h by day, 1 by night × 9 plots) for Diadema Araneae; approx. 30 h for saproxylic beetles	approx. 8 h (saproxylic beetles)	SRA: part of Diadema protocol; search in habitat plots(Araneae) OEP: search in favourable habitats, especially dead branches (other invertebrates)	Many Arthropoda living in vegetation. Here used especially for Araneae, saproxylic Coleoptera.

Table 4. — Summary of sampling techniques used: active and passive sampling from substratum. Caption: **NA**: not applicable; **OEP**: oriented expert positioning, with traps installed in the most favorable situations, without pre-determined sampling plan; **SRA**: stratified representative approach, involving pre-determined plots selected and sampled according to a strict sampling protocol.

Sampling techniques (code used)	Short description	Illustration	II-III.2015	VIII.2015	Sampling strategy, trap position	Targeted taxa
Emergence chamber (EXL)	Wood and branches that have been invaded by larvae are gathered and put in an enclosure to 'incubate' until the adult insects emerge. These chambers are arranged in an outdoor storage room, property of SEAG, during one year (e.g. description Touroult *et al.* 2010)	Fig. 8A, B	7 boxes with 5 to 10 kg of dead branches each	12 chambers (97 kg)	OEP: search for dead branches of small diameter, including branches girdled by *Onciderès* species	Mainly saproxylic Coleoptera
Soil sampling for earthworms	Manual investigation of soil samples dug out with a spade. Sample sizes : 25 × 25 × 20 cm and 1m² × 40 cm	Fig. 8E	Per plot: 3 samples of 25 × 25 × 20 cm, 1 sample of 1m² × 40 cm	NA	SRA: Diadema protocol, applied in 9 plots. OEP: in favourable micro-habitats of these plots	Oligochaeta (Annelida)
Winkler litter sampling (WIN)	This method consists of sieving a certain amount of litter and suspending it over a sieve for 48 hours in an enclosure. Animals leaving the litter fall through the sieve into a collecting jar below the sieve	Fig. 8C	17 sites (Gastropoda) 180 samples of 1 m² litter for DIADEMA	NA	OEP: in as many habitats a possible including favourable micro-habitats along the tracks (Gastropoda). SRA: 15 samples taken in each of the 9 DIADEMA plots (Arthropoda protocol)	Gastropoda and soil Arthropoda, including Formicidae (Hymenoptera)
Stream fish rotenone sampling	Use of ichthyotoxic (rotenone) which blocks the respiration of fish causing a rapid death. The rotenone is introduced upstream in a stream section which is delimited by fine mesh barrage nets (4 mm). The fish are collected using a hand net	Fig. 8F	22 samples (8 collected in two river sections, 6 in one section)	NA	SRA: search in all nearby streams and rivers, and riparian habitats, except Alama river which was too large	Actinopterygii
Bark spraying	First, a bright plastic tarpaulin is spread around the sampled tree trunk base and fixed on ground and trunk. Next, the bark is sprayed up to a height of 2 m with aerosol mixture cans containing pyrethroids. The area is sprayed two times. Within 30 minutes the Arthropoda fall off, are swept into vials and stored in 70% denatured EtOH for conservation. See Schmidl (2009)	Fig. 8D	110 samples in 11 plots (10 per plot)	NA	SRA: in 11 habitat plots, on a selection of different kind of trees and barks types	Arthropoda, mainly Coleoptera, especially Staphylinidae

Fig. 4. — Some of the collecting sites and techniques: **A**, drop zone forest clearing, with a high amount a freshly cut trees, and scattered SLAM traps; **B**, clearing, equiped with SLAM traps, automatic light trap and artificial spider web (ASW); **C**, active net collecting of butterflies on the "Sommet-en-Cloche" inselberg. Photos: A, B, Julien Touroult, C, Stéphane Brûlé.

Fig. 5. — Passive interception traps: **A**, windowpane flight intercept trap (FIT) suspended over a fallen tree crown; **B**, 6 meter Malaise trap (MT) set up over a fallen tree near the Alama river; **C**, SLAM traps on an inselberg forest edge; **D**, a buprestid beetle (Buprestidae) trapped in artificial spider web (ASW). Photos: A, B, D, Julien Touroult; C, Stéphane Brûlé.

the Diadema protocol, a few flight intercept traps (FITs) were also suspended for short periods of time within the canopy.

By applying such a large diversity of collecting techniques we aimed at a maximum assessment of the species diversity taking into account the complementary of the trapping strategies, i.e., flight intercept traps sample a high diversity of flying insects but hardly any Lepidoptera whereas light traps attract large numbers of Lepidoptera and much less other insect orders. For Cerambycidae (Coleoptera) some methods like fruit baited traps and UV light traps are not very efficient in terms of number of species obtained but they yield species that are very rarely collected with more efficient approaches like emergence chambers or flight intercept traps (Touroult *et al.* 2010).

Also within each category of traps, we tried to maximize complementarity. Among interception techniques (Fig 5A-C), Malaise and windowpane FITs have a very broad spectrum, but Malaise traps instead collect species that fly well and try to escape going to the top, while FITs target heavier flying species or species that have a fall reflex when they encounter an large obstacle. As demonstrated by Lamarre *et al.* (2012), windowpane FITs consistently collect significantly more Coleoptera and Blattodea than Malaise traps, which proved most effective for Diptera, Hymenoptera, and Hemiptera.

In pan traps (Fig. 6C), different colors attract different Diptera and Hymenoptera, e.g. arboreal Dolichopodidae (Diptera) are most attracted to blue or other dark colored traps, whereas the majority of the species in this fly family are most numerous in white and yellow colored traps (Pollet & Grootaert 1987, 1994). For that reason, the combination of these three colors is routinely used in dipterological surveys.

With respect to automatic light traps (Figs 4B, 6A), yet unpublished SEAG studies seem to indicate that the blue, pink and green/red LEDs collect a different range of species belonging mainly to Coleoptera, Hemiptera and Orthopteroidea.

Sampling strategies

Two very different sampling strategies (and some intermediate approaches) were applied simultaneously during the Mitaraka 2015 survey. The first consists in positioning traps or collecting in habitats and micro-habitats which are assumed to be the most favourable according to the experience of the specialist, without any pre-determined sampling plan. This includes, for example, walking around searching for trees that

Fig. 6. — Attractive traps: **A**, pink LED based automatic light trap (PVP) suspended at 15 m height close to a small canopy gap; **B**, light trap (LT) with light bulb of 125W and with white sheet, covered with moths at the end of a rainy night; **C**, colored pan traps (blue [BPT], white [WPT], and yellow [YPT]) at soil surface level to collect Diptera; **D**, fruit baited Coleoptera traps with banana nectar (BT), suspended in forest canopy; **E**, Nymphalidae butterfly trap (CHX), suspended in the forest canopy; **F**, tree equiped with ropes and baits composed of honey and tuna at different heights to attract ants; **G**, pitfall trap baited with dung (PFC) to collect coprophagous Scarabaeidae; **H**, Big Shot, a type of slingshot used to shoot ropes and suspend traps high up in the trees. Photos: A, B, G, H, Julien Touroult; C, Marc Pollet; F, Maurice Leponce; D, E, Stéphane Brûlé.

Fig. 7. — Active collecting techniques: **A**, collecting butterflies with a net; **B**, sweeping vegetation (NS or SW) with a rugged sweep net; **C**, beating tray (BS), the vegetation is hit with a stick, which causes the arthropods to fall on the white nape mounted on a frame; **D**, searching for aquatic larvae with a rugged aquatic net; **E**, looking for butterfly caterpillars (Riodinidae and Lycaenidae) on liana flowers; **F**, visual search for reptiles, here with a *Lachesis muta* (Linnaeus, 1766) snake. Photos: A, B, C, E, Stéphane Brûlé; D, Nicolas Moulin; F, Xavier Desmier.

died recently to set up Malaise traps for collecting xylophagous and saproxylic communities.

Since tropical forest communities are rich in rare species, with high alpha and relatively low beta (spatial turnover) diversity (Basset *et al.* 2012) and are generally highly under-sampled by any protocols (Coddington *et al.* 2009), the main sampling strategy has been to place traps in favourable configurations around the camp. For example, more than 20 SLAM traps and over 10 windowpane FITs were placed scattered within the small drop zone clearing adjacent to the base camp (Fig. 4A, B). This strategy which is regularly used by the SEAG team allows the collection of a large quantity of specimens, including rare species. The proximity of the traps minimizes the time needed to check them, freeing up time for active collecting.

As a result, samples are not randomized nor representative for the forest communities. However, this approach is expected to be highly efficient for species discovery.

The second strategy is a stratified representative approach and implies the investigation of pre-determined plots according to a strict sampling protocol, in the case of Mitaraka, based on environmental characteristics and distributed along the four trails.

The first approach has been dominant in this survey and covers in particular all broad-spectrum taxonomic traps. The second approach includes ecology protocols coordinated within the framework of Diadema, or inspired by Diadema.

Sampling efforts and strategies are given for each type of collecting method in Tables 1-4.

Fig. 8. — Active and passive substrate sampling: **A**, **B**, collection of dead branches infested with saproxylic larvae for "rearing" in emergence chambers (EXL); **C**, sampling soil litter for invertebrates with Winkler sieve (WS); **D**, spraying trunks with insecticide to collect small bark-dwelling arthropods that fall on the white sheet at the bottom of the trunk; **E**, searching for Annelida in soil samples collected with a spade; **F**, fish sampling in a small stream using rotenone. Photos: A, B, Stéphane Brûlé; C, Benoît Fontaine; D, Jürgen Schmidl; E, F, Xavier Desmier.

MANAGEMENT OF THE POST-FIELD PHASE

The different sampling techniques affect the entire sample processing phase (Figs 9, 10). Interception approaches, which often produce massive and unselective samples, require a significant sorting effort but often generate discoveries in many poorly known groups. In contrast, active search techniques that are limited to well-targeted groups allow the expert to select the material in the field, limit the volume of material to be sorted later on, and allow a swift recognition of novelties.

Sorting and dissemination among specialists

Post-field phases are generally considered sensitive steps in the process of an ATBI (Leponce *et al.* 2010, Villemant *et al.* 2015). Indeed, if the sorting and dissemination of the material is not properly managed, a lot of time might be wasted and the material often does not reach the taxonomic experts, compromising the whole process.

To facilitate this critical stage, one week of sample sorting for broad-spectrum traps (methods cited in Table 1 and automatic light traps in Table 2) was organised with some of the participants to the survey, directly after each of the 15-day field periods, one in Montjoly at the SEAG laboratory, the other in Kourou at the laboratory of the of the Campus agronomique. This first phase aimed at sorting yields to order and family when possible, especially in Coleoptera. The sorting was then continued for one month by SEAG members. Subsequently, coordinators or their teams took over, sorted samples into superfamily, family or sub-family fractions and disseminated those fractions to the respective taxonomic experts around the globe (Fig. 11).

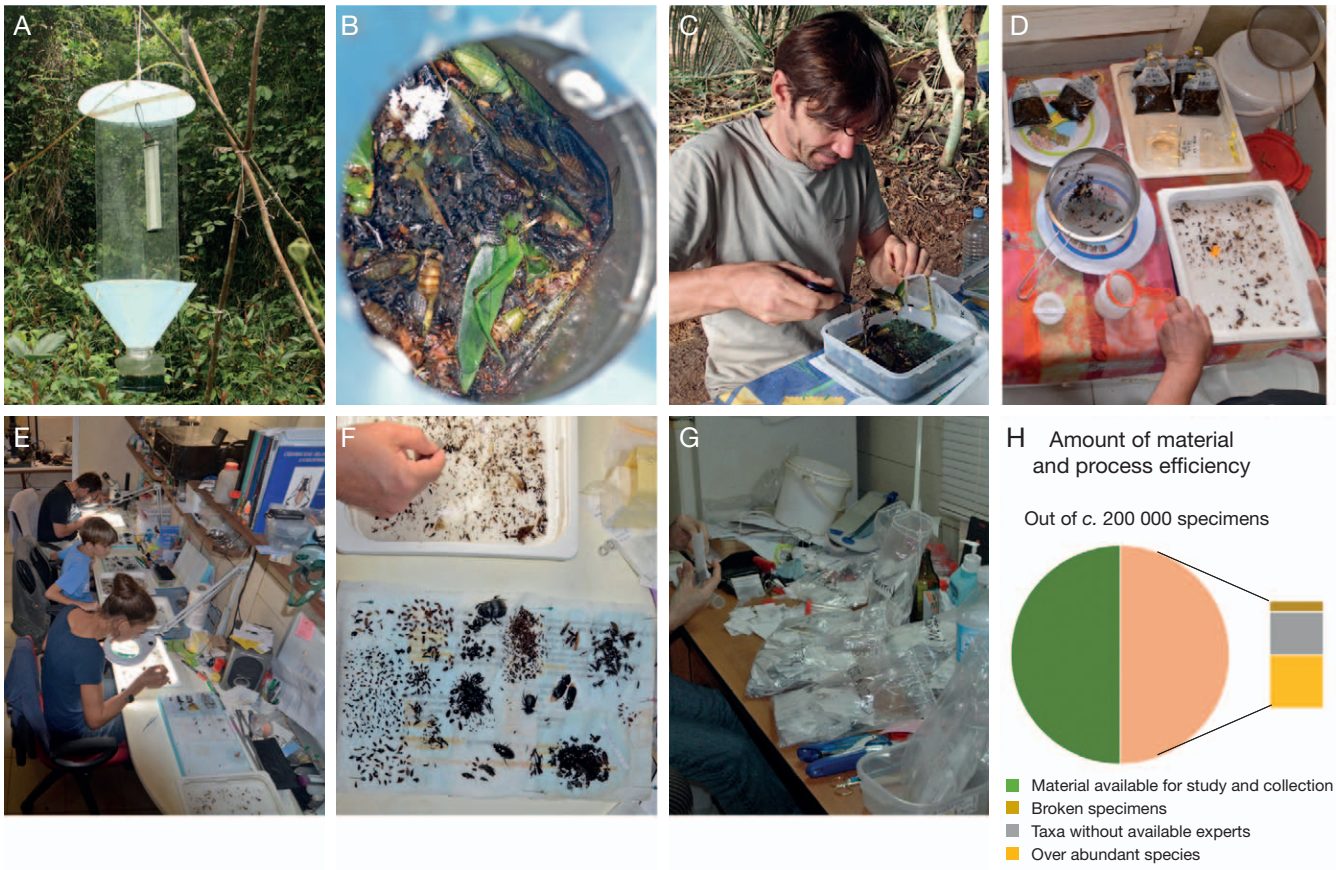

Fig. 9. — Sample size and sorting process according to the sampling type and impact on the quantity and availability of specimens for taxonomic study. Process for broad-spectrum traps: **A**, automatic light trap with blue LED; **B**, yield of the trap after one week; **C**, conditioning of the sample in the field laboratory, and storage in WhirlPack bags with alcohol; **D**-**F**, sorting specimens by order and family at the SEAG laboratory (Montjoly, French Guiana); **G**, preparing packages with glassine envelopes and Eppendorf vials for dissemination among coordinators and/or taxonomic experts; **H**, typical output of this kind of broad-spectrum trap samples: about 50% fraction may finally be studied (arbitrary estimate). Photos: Julien Touroult.

Fig. 10. — Process for active collecting: **A**, active collection of cricket (Orthoptera); **B**, photography of live specimens, important part of the process in some groups; **C**, preparation and management of the specimens for short term storage in the field laboratory; **D**, output of the active or selective methods: lower yields than broad-spectrum traps but a larger proportion is effectively studied. Photos: A, C, Xavier Desmier; B, Julien Touroult.

For the broad-spectrum trap samples, sorting by order was completed within three months after the field trip of March 2015. The Coleoptera could be distributed immediately afterwards because most of them had been sorted directly to family level. For the Diptera and Hemiptera, sorting was completed about 8-9 months after the field survey (approx. December 2015). For Hymenoptera, the process was lengthy due to difficulties in availability and specimen volume of SLAM and Malaise traps. Overall, leaving aside a few samples, all the material was distributed within 2.5 years after the major field trip of the survey.

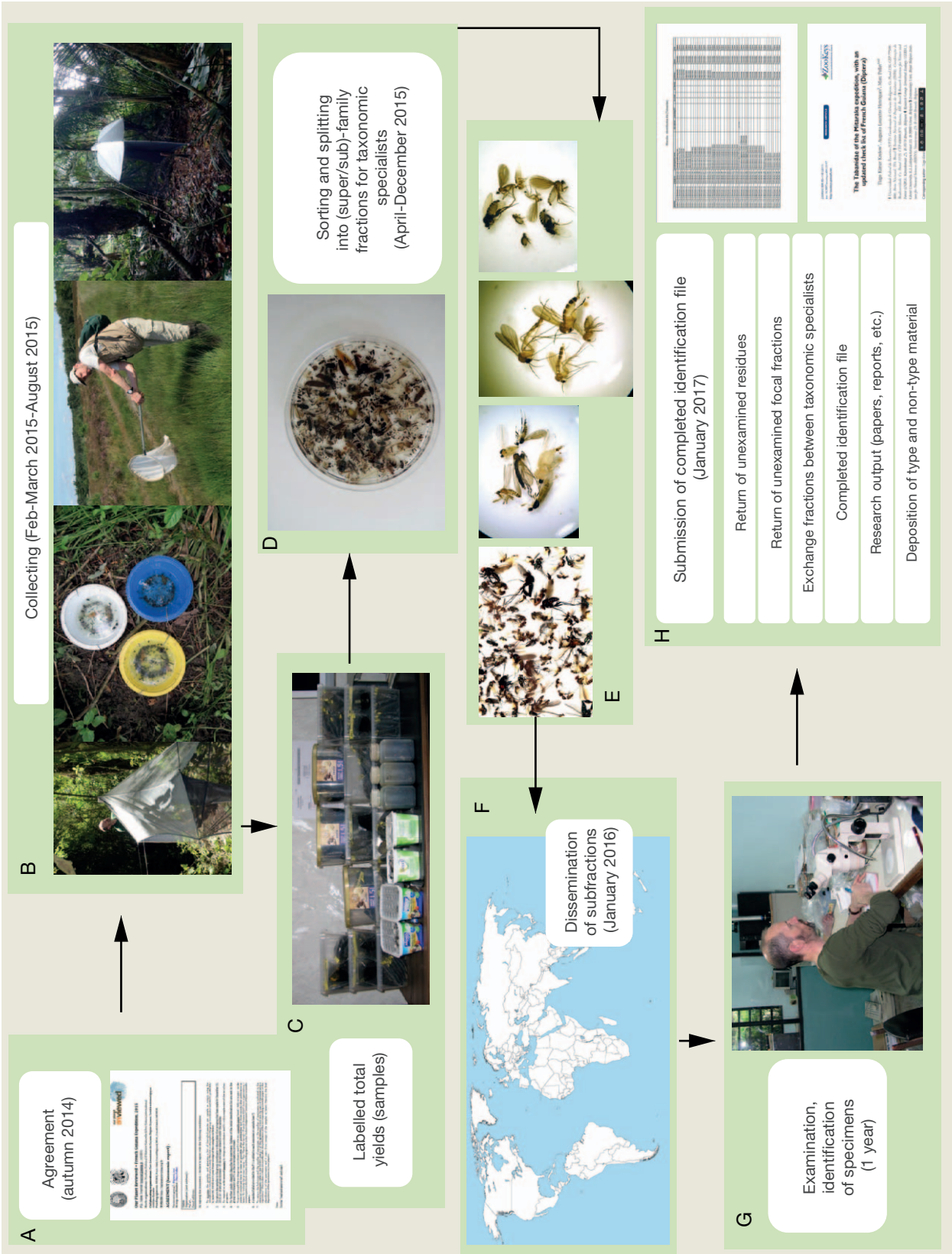

Fig. 11. — Process flow for Diptera: **A**, each Diptera coordinator and taxonomic expert signs an agreement prior to receiving samples; **B**, sampling specimens with an array of methods (Malaise trap, pan traps, sweep net, SLAM trap); **C**, transporting of partly processed and unprocessed samples to the Belgian lab; **D**, sorting Diptera from complete samples and splitting the Diptera fraction into workable fractions (mostly on family level) for Diptera coordinators – taxonomic experts; **E**, processed Diptera fractions (Dolichopodidae, Empidoidea, Mycetophilidae, Phoridae); **F**, dissemination of workable fractions to Diptera coordinators – taxonomic specialists (10 in Europe, 5 in Canada, 8 in the USA, 10 in Brazil); **G**, examination and identification of specimens of workable fractions by the taxonomic expert (or further splitting of fractions by Diptera coordinator); **H**, commitments as part of the signed agreement (see Fig. 11A), with submission of identification file as first.

These figures refer to the first field trip for taxonomy protocols. The material collected according to the Diadema protocol was sorted at the order level more than a year after the Feb.-March field trip.

Data management

The management of the produced data is another sensitive phase.

Several datasets have been created with metadata: one for the Feb.-March field trip, another for the August entomological field trip and another dataset will be used for Diadema data.

An online database, CardObs (https://cardobs.mnhn.fr/), developed by the MNHN to facilitate the entry of French data collected by naturalists was used (Fig. 12A). This application allows the user to associate a set of taxa (and certain attributes, i.e., number of specimens, the identifier, the collection or deposit) to a collection event (place, date(s), observer(s)/collector(s), collection methods). It is linked to TAXREF (Gargominy *et al.* 2017), a taxonomic framework, that provides species names. Taxa that are not (yet) recognized as described species (identified to the genus level only – often in case of females – or to the morphospecies level, e.g. distinct taxonomic entity without a published name), are assigned to the relevant genus or tribe. A free datafield is provided to store the morphospecies name assigned by the identifier (e.g. "Photinus sp23") or left empty if the genus is the most reliable level of identification.

A flexible approach was used for data entry. A dozen experts who wanted to use CardObs were granted direct access. Others submitted lists in a pre-determined format and the main coordinator imported them. This enabled the first data to be disclosed very quickly: on 22.IV.2015, less than one month after the end of the March 2015 field trip, records of the first 1000 identified species were available on the site of the national natural heritage inventory (Fig. 12B; INPN: https://inpn.mnhn.fr).

These data are considered as publicly available and the raw data are regularly transmitted to Guianese partners. Some data are already published on GBIF (Fig. 12D) and it is our goal to ultimately publish all the Mitaraka 2015 datasets to GBIF and possibly dedicate a data paper to it.

Another stage of entry concerns the deposition of specimens in institutional collections such as the MNHN. This is done in a collection-specific database and primarily concerns types (Fig. 12C). Specimens of the Mitaraka expedition (and previous field trips in this area) can be consulted on the following portal: https://science.mnhn.fr/institution/mnhn/item/search/form, entering in the keyword "Mitaraka".

Global follow-up of scientific results

An online monitoring spreadsheet (Google.Doc with information on expert/taxa/material sending date/return date etc.) completed by each group coordinator allowed the main coordinator (JT) to follow up the progress of the distribu-

Fig. 12. —Database and portals for entry, consultation and access to data, illustrated by means of a newly described Mitaraka species, *Eupromera pascali* Dalens, 2016 (Coleoptera, Cerambycidae): **A**, CardObs database entry interface (https://cardobs.mnhn.fr). The morphospecies name was initially entered as "*Eupromera* n. sp." in April 2015 and after publication (Feb. 2016), the morphospecies name was replaced by the species name, and the record was completed with publication reference and the collection deposit number; **B**, INPN French Natural Heritage consultation portal, displaying this species from the Mitaraka dataset (https://inpn.mnhn.fr/espece/cd_nom/814643/tab/rep/GUF); **C**, public interface to database of the Coleoptera collection (EC) of the MNHN illustrating the holotype and its labels, with full traceability (http://coldb.mnhn.fr/catalognumber/mnhn/ec/ec7591); **D**, International GBIF Data Portal displaying the Coleoptera collection (EC) dataset of the MNHN (https://www.gbif.org/occurrence/1413051340).

tion of the material and the return of identification lists and identified specimens.

Publications are also tracked. Their contents are subsequently analysed (e.g. new species, descriptions, biology, affiliation of authors, and quotation of material sources and deposition). New species and first species records for French Guiana are entered in the TAXREF species database as soon as they become available via scientific publications. The publication references are also linked to the data in the CardObs database, which are regularly updated by the main coordinator (Fig. 12A).

A key success factor in the rapid outreach of Mitaraka research results was the initiative by the editorial team of *Zoosystema* to dedicate an online fast track thematic issue to this expedition. This certainly motivated both coordinators and taxonomic experts to speed up the identification process, often including descriptions of new taxa.

CONCLUSION: TOWARDS A FIRST EVALUATION OF THE EXPEDITION RESULTS

This introductory paper to the Mitaraka survey precedes a series of faunistic, taxonomic and biodiversity articles based entirely or in part on the material collected in 2015 during the two field missions. Already in May 2018, over forty articles on Mitaraka material had been published in various scientific journals. Using the data and publications available, we will try to assess the short term scientific benefits and outreach to the public of the Mitaraka expedition for taxonomic discovery in French Guiana in a second paper.

The main question concerns the effectiveness in terms of publishing new species for science or first records for the territory of French Guiana. In other words, compared to the high background rate of discovery and taxonomic publications observed over the period 2003-2013 (Brûlé & Touroult 2014), does the Mitaraka expedition generate a significant increase of scientific discoveries? This question can be broken down into different areas that we intend to investigate. From a taxonomic point of view, have we been able to study orders or classes of invertebrates that were poorly known in French Guiana? Were experts unfamiliar to French Guiana involved in the study of the samples? For a few well-sampled groups in French Guiana, does the Mitaraka area harbour species that are obviously not or very rarely encountered elsewhere, and therefore would not have been discovered without this field mission?

If we compare with the terrestrial components of the other "Our Planet Reviewed" expeditions for which feedback is available, what are the particularities of the Mitaraka survey, in terms of discovered taxa, research output, etc.? And if differences are observed, how can they be explained?

A more pragmatic or even administrative issue is the management of traceability, the citation and deposition of specimens, requirements that will be strengthened with the implementation of the Nagoya protocol. In our Mitaraka case study, what is the proportion of publications that meets the different citation requirements? Does this vary according to the number of intermediaries between the taxonomist and the coordinator?

A technical feedback question, that could strengthen the organisation of biological inventories, concerns sampling methods and associated sample examination processes (see Figs 9-11). When both methods were used, did active and direct collecting make it possible to find and publish novelties more quickly than broad-spectrum traps? As demonstrated in Europe (Fontaine *et al.* 2012) and in French Guiana (Brûlé & Touroult 2014), non-professional taxonomists play an important and even predominant role in the production of taxonomic and biogeographic data. What was their role in the success of an institutional field trip like this?

With a quantitative synthesis of the results (data and publications) and a more qualitative feedback on the strengths and weaknesses of this major survey, we will try to answer these various questions in a second article that will conclude this series of Mitaraka papers in *Zoosystema*.

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APPENDICES – SUPPLEMENTARY MATERIAL

APPENDIX 1. — List of people involved in the field operations, Mitaraka 2015.

Name	First name	Status during operation	Scientific specialty	Membership organisation	Survey period	French Guiana resident
Allié	Elodie	researcher	plants	INRA	1	+
Auffret	Emeric	researcher, technicien	–	PAG	2	+
Baraloto	Christopher	researcher	plants	INRA	1	+
Barbut	Jérôme	researcher	entomology	MNHN	2	–
Bénéluz	Frédéric	researcher	entomology	SEAG	3	+
Benmesbah	Mohamed	physician	(entomology)	–	1 & 2	–
Braet	Yves	researcher	entomology	SEAG	2	–
Brosse	Sébastien	researcher	freshwater fish	Univ. Toulouse	2	–
Brûlé	Stéphane	researcher	entomology	SEAG	3	–
Cazal	Jocelyn	researcher, technicien	–	INRA	2	+
Chavance	Yann	journalist	–	–	1 & 2	–
Chevalier	Cyril	physician	–	–	2	–
Collet	Philippe	researcher	entomology	SEAG	3	–
Dalens	Pierre-Henri	researcher	entomology	SEAG	2 & 3	+
de Lavaissière	Marc	physician	–	–	3	–
Decaens	Thibaud	researcher	earthworms	Univ. Rouen	2	–
Desmier	Xavier	photographer	–	Indépendant	1 & 2	–
Dewynter	Maël	researcher	herpetology	Biotope/MNHN	1	+
Dummett	Olivier	camp assistant	–	–	1 & 2	+
Engel	Julien	researcher	plants	CIRAD	1	+
Faynel	Christophe	researcher	entomology	SEAG	3	–
Fernandez	Serge	camp manager	(entomology)	–	1 & 2	+
Fernandez	Mathias	camp assistant	(herpetology)	–	1 & 2	+
Fleck	Gunther	researcher	entomology	CBGP	2	–
Fleury	Marie	representative	–	MNHN	2	+
Fontaine	Benoît	researcher	terrestrial molluscs	MNHN	2	–
Fouquet	Antoine	researcher	herpetology	CNRS	1	+
Fournier	Didier	research assistant		Guyane prefecture	3	+
Gargominy	Olivier	researcher	terrestrial molluscs	MNHN	2	–
Geniez	Chantal	researcher	plants	IRD	2	+
Gonzalez	Sophie	researcher	plants	Herbier Cayenne	2	+
Hugel	Sylvain	researcher	entomology	CNRS-Univ. Strasbourg	1	–
Lamarre	Gregg	researcher	entomology	INRA	2	+
Lapied	Emmanuel	researcher	earthworms	IRD	2	–
Legendre	Frédéric	researcher	entomology	MNHN	1	–
Léotard	Guillaume	researcher	plants	ECOBIOS	2	+
Leponce	Maurice	researcher	entomology	IRSNB	1	–
Magniez	Thierry	pedagogy	–	MNHN	2	–
Mantilleri	Antoine	researcher	entomology	MNHN	2	–
Melki	Frédéric	researcher	freshwater fish	Biotope	2	–
Minot	Marceau	researcher	entomology	SEAG	3	–
Molino	Jean-François	researcher	plants	IRD	1 & 2	–
Murienne	Jérôme	researcher	entomology	CNRS	1	–
Orivel	Jérôme	researcher	entomology	CNRS	1	+
Pascal	Olivier	expedition manager		Pro-Natura	1 & 2	–
Petit-Clerc	Frédéric	researcher	entomology	CNRS	1	+
Pétronelli	Pascal	researcher	plants	CIRAD	1	+
Pignoux	Rémy	physician	(ornithology)	Médecin	1	–
Poirier	Eddy	researcher	entomology	SEAG	1, 2 & 3	+
Pollet	Marc	researcher	entomology	INBO	1	–
Poncy	Odile	researcher	plants	MNHN	1	–
Proux	Laetitia	camp assistant	–	–	1 & 2	+
Robin	Frédéric	researcher	entomology	SEAG	3	+
Rome	Quentin	researcher	entomology	MNHN	2	–
Roy	Mélanie	researcher	mushrooms	Univ. Toulouse	2	–
Sabatier	Daniel	researcher	plants	IRD	1 & 2	–
Schimann	Heidy	researcher	mushrooms	INRA	2	+
Schmidl	Jürgen	researcher	entomology	Univ. Erlangen	1	–
Smock	Jean-Louis	researcher	plants	IRD	1	+
Touroult	Julien	researcher	entomology	MNHN	1	–
Troispoux	Valérie	researcher	plants	INRA	1	+

APPENDIX 1. — Continuation.

Name	First name	Status during operation	Scientific specialty	Membership organisation	Survey period	French Guiana resident
Vedel	Vincent	researcher	entomology	ECOBIOS	1	+
Vidal	Nicolas	researcher	herpetology	MNHN	1	–
Vigouroux	Régis	researcher	freshwater fish	Hydreco	2	+
Villemant	Claire	researcher	entomology	MNHN	2	–
Yvinec	Jean-Hervé	researcher	entomology	SEAG	1	–

APPENDIX 2. — Model of participant agreement for the expedition.

Expédition Guyane 2014-2015	**French Guyana Expedition, 2014-2015**
Co-organisateurs : • **Muséum National d'Histoire Naturelle** • **Pro-Natura International**	**Co-organizers:** • **Muséum National d'Histoire Naturelle** • **Pro-Natura International**
Partenaires en Guyane: • **Parc Amazonien de Guyane** • **FEDER** • **Fonds Shell** • **Conseil Régional** • **DEAL** • **Conseil général** • **MENESSR**	**Local counterparts :** • **Parc Amazonien de Guyane** • **FEDER** • **Fonds Shell** • **Conseil Régional** • **DEAL** • **Conseil général** • **MENESSR**
FICHE PARTICIPANT et/ou VISITEUR **CONDITIONS GÉNÉRALES**	**PARTICIPANT and/or VISITOR FORM** **GENERAL CONDITIONS**
Je soussigné(e), **XXXX** …..... Adresse personnelle : **XXX** …… Organisme ou société : **XXX** .....……. Siège (adresse) : XXX ..... Nationalité : **XX** Personne à prévenir en cas d'accident (nom, téléphone, email)	I, the undersigned (Print name), ...……. Personal address: ....…… Institution or company: .....:…… Institution/Company address: .....……

APPENDIX 2. — Continuation.

	.....
Intervenant sur la Mission "La Planète Revisitée - Guyane 2014-2015" en qualité de :	Nationality: .....
Participant scientifique	Person to be contacted in case of accident (name, telephone, email address)
Déclare avoir pris connaissance et avoir accepté pleinement les dispositions des Conditions Générales jointes (p.2) et dont l'observation conditionne la poursuite de ma participation et/ou de ma visite sur le(s) site(s) de la Mission, sans préjudice de tous dommages & intérêts en cas de non-respect de celles-ci.	.....
	Participating in the “Our Planet Reviewed – French Guyana 2014-2015" Expedition as a :
	Scientific Participant / media / logistical staff / visitor (circle one)
Fait à Paris	
le : 16 octobre 2014, en deux exemplaires (dont un à conserver par le participant)	Declare that I have read and fully accept the General Conditions attached (p.2), and I understand that observing them is a condition for my participation and/or visit to the site(s), and that any infraction on my part may lead to legal action against me.
Signature et mention :	
	Prepared in duplicate at (place)……
	(one to be kept by the participant)
(mention manuscrite : "Lu et approuvé, bon pour acceptation des Conditions générales ci-jointes")	Date:……..
	Signature:
	(Please write in your own hand: ”I accept the General Conditions" and sign)

APPENDIX 2. — Continuation.

CONDITIONS GÉNÉRALES	GENERAL CONDITIONS
1 - Les présentes Conditions Générales s'appliquent à toute personne physique ou morale ou au représentant de celle-ci qui participe à la mission « La Planète Revisitée – Expédition Guyane, 2014-2015».	1 -The present General Conditions apply to all individuals and institutions or their representatives who participate in the « Our Planet Reviewed – French Guiana 2014-2015 expedition».
2 - Une convention « Accès et Partage des Avantages » a été signée entre le Muséum National d'Histoire Naturelle et la Région Guyane. Pour satisfaire aux obligations découlant de cette Convention, le participant s'engage à ne collecter échantillons et données que pour un but de recherche fondamentale et de gestion. Par "recherche fondamentale et de gestion", sont exclues les finalités commerciales et industrielles.	2 – An agreement on "Access and Benefit Sharing" has been signed between the Muséum National d'Histoire Naturelle and the Région Guyane. To comply with the terms of this agreement, the Participant/Visitor commits to collect information and specimens for academic and management purposes only. Under "academic and management purposes" the parties include any purpose other than commercial and industrial.
3 - Le participant et/ou visiteur devra, avant l'accès au site quel qu'il soit, avoir pris les mesures (notamment les vaccins en cours de validité, en particulier la fièvre jaune) indispensables ou nécessaires pour s'immuniser contre les maladies tropicales. Pour la composante terrestre, il devra produire un certificat médical de non contagion (à envoyer sous format électronique) et, dans la mesure du possible, être pourvu d'une trousse de première nécessité car l'assistance médicale sera limitée sur la mission (un médecin accompagnera les équipes dans le massif du Mitaraka). Il devra dans tous les cas être pourvu de ses médicaments personnels en cas de traitement.	3 - Before accessing any site, the Participant/Visitor must take all measures to prevent tropical diseases (especially ensuring that vaccinations, in particular the yellow fever, are valid and up to date in their International Certificate of Vaccination). For the terrestrial component, he must provide a medical certificate attesting the absence of contagious risk and send it by email. A personal First Aid Kit is recommended, including personal medications in case of illness or injury. Limited medical assistance will be available during the terrestrial expedition (a physician will accompany the scientific team at the Mitaraka mountains). Whatever, he must take his own medicines in case of treatment.
4 - L'Assureur « Responsabilité Civile » des Organisateurs a accepté de renoncer à tout recours contre tout participant et leurs assureurs si le participant est assuré, sous réserve de réciprocité, tant de la part des participants que de la part de leurs assureurs. Les Organisateurs ont souscrit pour tous les participants autres que les « visiteurs » une assurance individuelle accident et une assistance rapatriement. Si le participant a souscrit une assurance assistance couvrant son rapatriement en cas d'accident pour la durée de son déplacement et qu'il souhaite que celle-ci soit activée en priorité, il s'engage à le signaler aux organisateurs et à remettre avant son départ pour l'opération, les coordonnées de cette assistance avec son numéro de garantie et un numéro d'appel 24/24, ainsi que le nom de la personne à contacter en cas de nécessité à : Olivier Pascal oli.pascal@gmail.com pour la composante terrestre et à Alice Leblond alice.leblond@mnhn.fr pour la composante marine. Les Organisateurs attirent cependant l'attention de tout participant sur le fait que la grande majorité des contrats d'assistance rapatriement ne prend en charge les victimes qu'à partir d'un aéroport international, (Cayenne dans le cas de la Guyane). La plupart des contrats ne couvre pas le risque «primaire » et, en général, ne l'organise jamais (évacuation entre le lieu de l'accident et l'aéroport international). Si vous nous demandez d'activer en priorité votre assurance, nous devrons malgré tout (à moins que votre contrat le spécifie autrement) organiser l'évacuation jusqu'à l'aéroport	4 – The co-Organizers' General Third Party Insurers have agreed to waive recourse against any Participant and their insurers (if any) subject to the Participant and/or their insurers (if any) reciprocally waiving recourse. The organizers provide all participants (other than "visitors") with a personal accident insurance and with an evacuation / repatriation insurance. If the participant declares to have insurance coverage for his/her repatriation in the event of accident and he/she wants it to be activated as a priority, he/she should notify us and provide us the references and phone number of the relevant insurance before departure from the home country, and with the name of person(s) to contact in case of emergency. This information must be provided to: Olivier Pascal oli.pascal@gmail.com for those participating in the terrestrial component and to Alice Leblond alice.leblond@mnhn.fr for those participating in the marine component. The co-Organizers draw the Participant's attention to the fact that most Assistance and Repatriation contracts only cover travel from an international airport (Cayenne for French Guiana). If you have secondary medical travel insurance, you should determine if the coverage covers preexisting conditions or has age restrictions, make sure that the policy provides for medical evacuation and repatriation to your point of departure (in the emergency medical transportation portion of your Policy) and carefully check the exclusions in your contract: we have to know whether the search and rescue and the evacuation costs between the accident site and the international airport are covered.

APPENDIX 2. — Continuation.

international, lieu à partir duquel, n'importe quelle assurance rapatriement assure l'organisation et la prise en charge de l'évacuation (le risque dit « secondaire »). En aucun cas les organisateurs ne pourront être tenus pour responsable de la non possibilité d'acheminer une victime vers l'aéroport international que ce soit en termes de délais ou de moyens matériels. 5 – Le participant et/ou visiteur s'engage à respecter les consignes des représentants de la direction du projet et celles des responsables désignés dans chaque module. 6 – Le participant s'engage à mettre à la disposition du projet les photographies scientifiques de spécimens pris sur le terrain ou au laboratoire, en particulier pour alimenter le site internet de l'expédition, et d'une manière générale pour participer à la communication sur le projet et à la restitution des résultats en direction des autorités de Guyane. Ces photos seront, le cas échéant, toujours publiées avec le nom de leur auteur. Le participant n'est pas autorisé à donner ou vendre ses photographies auprès des média commerciaux pendant trois ans après la signature de la présente. Les utilisations habituelles des photographies aux fins de recherche, formation et enseignement, y compris sur un site ou un journal institutionnels, ne sont pas restreintes par le présent accord. 7 – Le Participant s'engage à ne communiquer qu'auprès des média qui auront été mis en relation avec lui/elle par le service presse de l'expédition. 8 –**Publication et traçabilité des échantillons**. Toute publication réalisée par le participant et/ou le visiteur relative à son expérience et/ou aux travaux effectués par lui sur le ou les sites et/ou à l'occasion de l'expédition devra faire référence à l'expédition elle-même sous la dénomination "Expédition Muséum National d'Histoire Naturelle de Paris / Pro-Natura International– La Planète Revisitée, Guyane 2014-2015". L'auteur devra s'enquérir auprès du/des responsables de l'expédition des mentions additionnelles qui pourraient être nécessaires dans un paragraphe "Remerciements". Cette information figurera également sur les étiquettes et/ou tout autre document accompagnant les échantillons ou d'autres résultats des recherches conduites dans le cadre de la mission « La Planète Revisitée – Expédition MNHN / PNI Guyane 2014-2015». 9. **Collections**. Les holotypes d'espèces nouvelles décrites sur la base du matériel collecté lors de l'expédition devront être déposés au MNHN. Dans le cas où le matériel type provient de plusieurs sources, au moins un paratype sera déposé au MNHN. Des paratypes peuvent être déposés dans d'autres collections publiques ou privées. La destination des échantillons non-types, étudiés par les participants ou leur propre réseau de collaborateurs, pourra être discutée avec les Organisateurs. Au minimum, une collection représentative sera déposée au MNHN et une autre en Guyane. Dans le cas des échantillons botaniques,	If you ask us to activate your insurance as a priority, we may nevertheless (unless your contract specifies otherwise) have to organize the evacuation to the international airport in Port Moresby, from which place, repatriation insurance normally covers organization and management of the evacuation. Under no circumstances will the co-Organizers be held liable for the non-delivery of a person to an International Airport, either with regard to timing or availability of resources. 5 – The Participant/Visitor commits to follow the rules and regulations laid down by the representative of the Organizers. 6 –The Participant/Visitor agrees to place scientific photographs of specimens taken in the field or in the lab at the free disposal of the project, notably to be used for its web site, and more generally for communication about the project in the media and for repatriation of information to the authorities of French Guiana. All such photos will be attributed to their author. The participant is not allowed to sell or give photographs to commercial media for three years after the signing of this form. Bona fide academic uses, including publication on a web site or in-house magazine, are not restricted by the present agreement. 7 – The Participant/Visitor agrees to communicate with only those media that have been put in touch with him/her by the Organiser's press department. 8 – Publication and samples traceability. Any publication by the Participant/Visitor concerning research and/or work performed at the site and/or during the Expedition must cite the Expedition itself with the following denomination " Muséum National d'Histoire Naturelle de Paris / Pro-Natura International / 'Our Planet Reviewed' Initiative, Guyane 2014-2015 Expedition". Authors shall enquire with their theme leaders which additional information must be mentioned under "Acknowledgements". This information must also appear on the labels and/or other documentation accompanying specimens or other research materials collected during the field survey « La Planète Revisitée – Expédition MNHN / PNI Guyane 2014-2015». 9. Collections. Holotype of new species described based on material collected during the expedition will be deposited in MNHN. In the case where the type material originates from multiple expedition sources, at least one paratype will be deposited in MNHN. Paratypes can be deposited in other public and private collections. The final repository of material other than types, studied by the participants or their own network of specialists, is open to discussion with the organizers. Minimally, a representative collection will be deposited in MNHN and another one in French Guiana. In the case of botanical

APPENDIX 2. — Continuation.

deux parts au moins seront destinées aux herbiers de Paris et Cayenne. Le participant s'engage à ne rediriger le matériel de l'expédition qu'à un réseau de spécialistes défini avec les Organisateurs. Les prêts d'échantillons seront soumis aux conditions définies aux articles 8 à 10. Pour le cas des spécimens entomologiques des contrats seront envoyés aux responsables taxonomiques désignés et aux experts taxonomiques identifiés pour leur étude. 10. **Communication des données**. Le participant s'engage à communiquer aux Organisateurs en temps utile toutes les données (liste d'espèces observées/collectées, y compris des morpho-espèces, données quantitatives, localisation des spécimens) permettant la traçabilité des résultats, leur mise en ligne sur le site de Inventaire National du Patrimoine Naturel (INPN), et leur restitution aux autorités guyanaises.	samples, two parts at least will be deposited in the herbaria of Paris and Cayenne. Specimens dissemination. The participant agrees to distribute specimens originating from the expedition only to a network of specialists defined with the Organizers. Loans to third parties will be subject to the conditions laid in Articles 8 to 10. For entomological spécimens, agreement forms will be sent to appointed « taxonomic coordinators » and « taxonomic experts ». 10. Sharing of information. The participant commits to feed to the organizers in due course information (lists of species observed/collected, including morphospecies, quantitative data, geolocation of specimens) to ensure the traceability of the results, their online availability on the Inventaire National du Patrimoine Naturel (INPN) website, and data sharing with the authorities of French Guiana.

APPENDIX 3. — Model of group coordinator agreement for the expedition.

Our Planet Reviewed – French Guiana Expedition, 2015

P.I.: Julien Touroult (touroult@mnhn.fr ; MNHN)

Hosts organisations: Muséum National d'Histoire Naturelle & Pro-Natura international

Collaborating organisations: Parc Amazonien de Guyane, Région Guyane, Société entomologique Antilles-Guyane

Funding agencies: **FEDER, Fonds Shell, Conseil Régional, DEAL, Conseil Général, MENESR**

Website: http://laplaneterevisitee.org/fr

AGREEMENT (co-ordinator):

……[1]

Name:
Organisation (and address)[2]:
Tel n°.:
Email address:

By signing this document, I declare to agree with the following conditions:

1. To provide the PI with a list of taxonomic experts (names / Institutions / email adresses) to whom specimens will be dispatched.
2. To send the form entitled "Agreement – Taxonomic Expert" to the selected experts and once received signed, to send it back to the PI in an electronic format before the delivery of specimens.
3. If not already done by the sorting team in Cayenne/Kourou, to split up the specimens in the vials into fractions according to the expertise of the taxonomic experts involved in this project. These samples will be labelled according to the sample list and codification rules.
4. To disseminate the samples to the above taxonomic experts, within one/three months after the receipt of the material by the P.I., and to return the possible residual samples to the P.I., if applicable.
5. To contact the P.I. in case vials are detected that obviously do not belong in the package, in order to work out a solution.

[in case you also act as taxonomic expert]

[1] Add exact taxonomic group you will deal with.
[2] This address will be used as mailing address.

APPENDIX 3. — Continuation.

6. To process the samples, and generate a list of (morpho)species per sample as output, using the *identification list (Excel sheet provided)*. This list is returned to the group P.I. preferably by **june 30, 2015 / December 31, 2015,** and **1 year from receipt of the samples at latest**.
7. To return the samples to the P.I. without delay if no progress has been made by December 31, 2015, or - at any given moment - if I do not longer intend to study the samples.
8. To respond to a **bi-annual inquiry** by the P.I. with a simple state-of-the-art of my progress.
9. To further study, identify/describe the specimens. Updates of the initial identification list are sent to the P.I. as the investigations proceed.
10. To provide a pdf file to the P.I. of every scientific paper based – fully or in part - on the material concerned here, **as soon as possible after publication** and three months after publication at latest. To include the project name : "Our Planet Reviewed – French Guiana 2015", host organisations / counterparts in the host country and funding agencies in the Acknowledgements section of those scientific papers.
11. A standard label provided by the P.I. is added to each specimen or sample (see 8).
12. To return the holotype and the number of paratypes, or the number of specimens, as indicated in the return/retainment table to the MNHN (see p. 2 of this agreement) which acts for part of the material as a repository[3]. This is done within six months after the publication of the corresponding scientific paper or the identification of the specimens, and 5 years from receipt of the samples at latest. Mention the final depository of the specimens in your papers.

Date:

"read and approved"

[3] According to agreements made with the Conseil Régional de Guyane, part of this material should return to this institution (see p. 2).

APPENDIX 3. — Continuation.

Our Planet Reviewed – French Guiana Expedition, 2015

P.I.: Julien Touroult (touroult@mnhn.fr ; MNHN)

Hosts organisations: Muséum National d'Histoire Naturelle & Pro-Natura international

Collaborating organisations: Parc Amazonien de Guyane, Région Guyane, SEAG

Funding agencies: **FEDER, Fonds Shell, Conseil Régional, DEAL, Conseil Général, MENESR**

Website: http://laplaneterevisitee.org/fr

This arrangement is of a temporary and practical nature, as part of the material should return to French Guiana.

Return/retainment table

New species

no specimens	new species ¶	
	MNHN	Retained by the expert
1	HT	-
2	HT + 1 PT	-
3	HT + 1 PT	1 PT
4	HT + 1 PT	2 PT
5	HT + 2 PT	2 PT
6	HT + 3 PT	2 PT
7	HT + 3 PT	3 PT
8	HT + 4 PT	3 PT
9	HT + 4 PT	4 PT
10	HT + 5 PT	4 PT
> 10	HT + at least 50% PT	at most 50%

HT: holotype specimen ; PT: paratype specimens

For this type material, it has to be returned mounted.
This rule apply only for paratypes coming from the LPR expedition.

APPENDIX 3. — Continuation.

Other species

A representative sample of the species collected has to be returned to the MNHN; which will be later dispachted between MNHN collection and French Guiana.

no specimens		
	MNHN	Retained by the expert
1	0	1
2	1	1
3	2	1
4	2	2
5	3	2
6	3	3
7	4	3
8	4	4
9	4	5
10	4	6
> 10	Max 10	The rest

Please note that specimens n° 1 to 5 should preferably be return mounted to MNHN.

Labels to be added to each species sample

1st label : Trap method, trap number, collector, precise date

2nd label (compulsory) : standard label provided by the P.I., including APA number : La Planète Revisitée – MNHN / PNI Guyane 2015 - APA-973-1 / GPS coordinate / collecting period.

Address for return of material : Corresponding MNHN collection manager, responsible for the LPR collection management.

APPENDIX 4. — Model of taxonomic expert agreement for the expedition.

Our Planet Reviewed – French Guiana Expedition, 2015

P.I.: Julien Touroult (touroult@mnhn.fr ; MNHN)

Hosts organisations: Muséum National d'Histoire Naturelle & Pro-Natura international

Collaborating organisations: Parc Amazonien de Guyane, Région Guyane, Société entomologique Antilles-Guyane

Funding agencies: **FEDER, Fonds Shell, Conseil Régional, DEAL, Conseil Général, MENESR**

Website: http://laplaneterevisitee.org/fr

AGREEMENT (taxonomic expert) :

Taxonomic group[1] **:**

Group coordinator:

Name:
Organisation (and address)[2]:
Tel n°.:
Email address:

By signing this document, I declare to agree with the following conditions:

1. To process the samples, and generate a list of (morpho)-species per sample as output, using the *identification list (Excel sheet provided)*. This list is returned to the group coordinator and the P.I. preferably by **june 30, 2015** and **1 year from receipt of the samples at latest**.
2. To return the samples to the group coordinator without delay if no progress has been made by December 31, 2015, or - at any given moment - if I do not longer intend to study the samples(**Not applicable to Amphibians and Reptiles**).
3. To respond to an **bi-annual inquiry** by the group coordinator and P.I. with a simple state-of-the-art of my progress.

[1] Add exact taxonomic group you will deal with.
[2] This address will be used as mailing address.

1

APPENDIX 4. — Continuation.

4. To further study, identify/describe the specimens. Updates of the initial identification list are sent to the group coordinator and P.I. as the investigations proceed.
5. To provide a pdf file to the group coordinator and P.I. of every scientific paper based – fully or in part - on the material concerned here, **as soon as possible after publication** and three months after publication at latest. To include the project name : "Our Planet Reviewed – French Guiana 2015", host organisations / counterparts in the host country and funding agencies in the "Acknowledgements" section of those scientific papers.
6. A standard label provided by the P. I. is added to each specimen or sample (see 7) (**Not applicable to Amphibians and Reptiles**)..
7. To return the holotype and the number of paratypes, or the number of specimens, as indicated in the return/retainment table to the MNHN (see p. 2 of this agreement) which acts for part of the material as a repository[3]. This is done within six months after the publication of the corresponding scientific paper or the identification of the specimens, and 5 years from receipt of the samples at latest. Mention the final depository of the specimens in your papers.

Date:

Red and approved

[3] According to agreements made with the Conseil Régional de Guyane, part of this material should return to this institution (see p. 2).

2

APPENDIX 4. — Continuation.

Our Planet Reviewed – French Guiana Expedition, 2015

P.I.: Julien Touroult (touroult@mnhn.fr ; MNHN)

Hosts organisations: Muséum National d'Histoire Naturelle & Pro-Natura international

Collaborating organisations: Parc Amazonien de Guyane, Région Guyane, SEAG

Funding agencies: **FEDER, Fonds Shell, Conseil Régional, DEAL, Conseil Général, MENESR**

Website: http://laplaneterevisitee.org/fr

This arrangement is of a temporary and practical nature, as part of the material should return to French Guiana.

Return/retainment table

New species

no specimens	new species ¶	
	MNHN	Retained by the expert
1	HT	-
2	HT + 1 PT	-
3	HT + 1 PT	1 PT
4	HT + 1 PT	2 PT
5	HT + 2 PT	2 PT
6	HT + 3 PT	2 PT
7	HT + 3 PT	3 PT
8	HT + 4 PT	3 PT
9	HT + 4 PT	4 PT
10	HT + 5 PT	4 PT
> 10	HT + at least 50% PT	at most 50%

HT: holotype specimen ; PT: paratype specimens

For this type material, it has to be returned mounted.
This rule apply only for paratypes coming from the LPR expedition.

APPENDIX 4. — Continuation.

Other species

A representative sample of the species collected has to be returned to the MNHN; which will be later dispachted between MNHN collection and French Guiana.

no specimens		
	MNHN	Retained by the expert
1	0	1
2	1	1
3	2	1
4	2	2
5	3	2
6	3	3
7	4	3
8	4	4
9	4	5
10	4	6
> 10	Max 10	The rest

Please note that specimens n° 1 to 5 should preferably be return mounted to MNHN.

Labels to be added to each species sample

1st label: Trap method, trap number, collector, precise date

2nd label (compulsory): standard label provided by the P.I., including APA number : La Planète Revisitée – MNHN / PNI Guyane 2015 - APA-973-1 / GPS coordinate / collecting period.

Address for return of material :

Corresponding MNHN collection manager, responsible for the LPR collection management.

Name will be given later by the group coordinator.

Email address: