Twin lakes Aunde and Piunde near the 3700 m site and huts that accommodated the members of the expedition.
(Photo © Xavier Desmier).

Organizing large-scale inventories of biodiversity in the tropics: the genesis and lessons of the project Our Planet Reviewed Papua New Guinea – land component

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ABSTRACT

Large-scale biodiversity inventories are useful for identifying the wide range of components of the forest ecosystem, which is a necessary step in understanding how they function and how they respond to environmental and climate changes. They require the coordination of large teams of experts in the collection and study of a huge variety of taxa surveyed. Here we use the project "Our Planet Reviewed – Papua New Guinea", assessing the biological diversity along a rainforest elevational gradient, as an example to illustrate the challenges of implementing such large-scale studies. We also draw lessons for future similar inventories. The project implementation follows a 10-step standard process: (1) design of the scientific program and aims (often a trade-off between feasible sampling effort and sample representativeness); (2) fundraising from public and private funders; (3) reconnaissance missions and partnerships with local stakeholders; (4) constitution of the field and laboratory research teams; (5) obtaining research and collecting authorizations; (6) preparation of the main survey, including botanical inventories, building insect traps and testing sampling protocols; (7) main survey, *i.e.* collection of specimens with standardized mass collection methods; (8) on-site pre-processing of the material by para-taxonomists and students

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to higher taxonomic levels (*e.g.* orders) and exporting specimens; (9) finer sorting (*e.g.* to family level) by Taxonomic Working Group (« TWiG ») leaders and dispatching of specimens to experts for identification to (morpho-)species level; (10) centralization of data in a collective database. Our experience shows that the main bottleneck in the data flow is the processing of the huge quantity of collected specimens in stages 8, 9 or 10. Solutions include securing sufficient funding for this critical step, training local para-taxonomists to assist main investigators and focusing on a limited number of informative yet tractable taxa. These inventories play an important role as the first step towards habitat conservation, demonstrating their value for biodiversity and providing sustainable local employment when research projects are continued, as is the case at Mount Wilhelm.

RÉSUMÉ

Organiser des inventaires de la biodiversité à grande échelle dans les tropiques : la genèse et les enseignements du projet La Planète Revisitée – Papouasie-Nouvelle-Guinée - volet terrestre.

Les inventaires de biodiversité à grande échelle sont utiles pour identifier les différentes composantes de l'écosystème forestier, ce qui constitue une étape nécessaire pour comprendre leur fonctionnement et leur réponse aux changements environnementaux et climatiques. Ils requièrent la coordination de nombreuses équipes de chercheurs experts dans la récolte ou l'étude des spécimens. Nous utilisons ici le projet «La Planète Revisitée – Papouasie-Nouvelle-Guinée», dont le but est d'évaluer la diversité biologique le long d'un gradient d'altitude, comme exemple pour illustrer la mise en œuvre de telles études à grande échelle. Nous en tirons également des enseignements pour de futurs inventaires du même type. La mise en œuvre du projet suit un processus standard en 10 étapes : (1) conception du programme et des objectifs scientifiques (souvent un compromis entre l'effort d'échantillonnage et sa représentativité) ; (2) collecte de fonds auprès de bailleurs publics et privés ; (3) missions de reconnaissance et partenariats avec les acteurs locaux ; (4) constitution des équipes de recherche de terrain et de laboratoire ; (5) obtention des autorisations de recherche et de récolte ; (6) préparation de l'inventaire principal incluant les inventaires botaniques, la construction de pièges à insectes et les essais des protocoles d'échantillonnage ; (7) l'inventaire principal, consistant en la récolte de spécimens avec des méthodes d'échantillonnage de masse standardisées ; (8) prétraitement sur place du matériel par des para-taxonomistes et des étudiants à des niveaux taxonomiques supérieurs (par exemple, ordres) et exportation des spécimens ; (9) tri plus fin (par exemple, au niveau de la famille) par les responsables des groupes de travail taxonomique (« TWiG ») et envoi des spécimens aux experts pour identification au niveau de la (morpho-)espèce ; (10) centralisation des données dans une base de données collective. Notre expérience montre que le principal goulot d'étranglement dans le flux de données est le traitement de l'énorme quantité de spécimens collectés au cours des processus 8, 9 ou 10. Les solutions consistent à assurer un financement suffisant pour cette étape critique, à former des techniciens de recherche (para-taxonomistes/écologistes) pour assister les chercheurs principaux et à se concentrer sur un nombre limité de taxons informatifs, faciles à traiter. Un rôle important de ces inventaires est qu'ils constituent la première étape vers la conservation des habitats, en démontrant leur valeur en termes de biodiversité et en fournissant des emplois locaux durables lorsque les projets de recherche sont poursuivis, comme c'est le cas au Mont Wilhelm.

INTRODUCTION

This chapter completes the introductory chapter of the first volume of "Insects of Mount Wilhelm - Papua New Guinea" where the general sampling protocol of the land component of the "Our Planet Reviewed – Papua New Guinea" biodiversity survey was presented (Leponce *et al.* 2016). This biodiversity inventory was mainly motivated by the fact that the estimates of the diversity of tropical arthropods (Hamilton *et al.* 2010; Hamilton *et al.* 2013; Stork 2018) are based on the results of studies carried out in lowland forests (Novotny *et al.* 2002) and do not take into account the multiplier effect of the altitudinal factor. To study this effect it was necessary to find a tropical mountain with a continuous forest cover from sea level to the natural limit of forest distribution. Such a system becomes difficult to find nowadays due to the widespread deforestation of lowland forests. Mount Wilhelm, the highest peak in Papua New Guinea (4509 m a.s.l.) was an ideal location for a project of this nature as it possesses a continuum of forests with little or no disturbance. Its elevational gradient spans from "mixed lowland rainforest" up to "upper montane forest" (Johns 1982). Between October and November 2012, we carried out a semi-simultaneous sampling at 8 different altitudes (every 500 m between 200 and 3700 m above sea level) and concentrated over 16 days. Very basic field camps were available at each study site. Five

mass sampling methods were used to collect arthropods. Twenty flight interception traps per altitude were deployed and were specifically aimed at Coleoptera collection (2880 trap-days). Four Malaise traps per altitude were used to collect Diptera, Hymenoptera or Hemiptera (576 trap-days). To specifically catch fruit flies, five Steiner traps with three types of attractants were placed at each altitude (720 trap-days). Vegetation beating, useful for collecting spiders, ants and other understory organisms, was carried out in 5 plots 20x20 m per altitude (10 samples per plot). Three of these plots were used as botanical plots to characterize the vegetation. Localized fumigation of the bark of a total of 324 trees was also carried out. The combination of these protocols allowed the sampling of most major arthropod orders covering a wide range of ecosystem functions (predators, scavengers, decomposers, leaf-chewers, sap-suckers, pollinators). A total of 63 persons (11 nationalities) were involved in the field survey, including 21 para taxonomists/ecologists, 21 international experts, four students (two local and two international), three journalists (film makers, photographers) and a support staff of 11 persons (coordinators, technicians, logisticians and medical doctors).

Here we examine in more details the pre- and post-survey sequence of steps in an attempt to draw general lessons applicable to similar future projects. We have identified 10 main steps in the implementation of such biodiversity inventories.

STEP 1. SCIENTIFIC PROGRAM DESIGN

The premises of the project were conceived in Brussels in December 2009. Back then, a research group of the IBISCA (Investigating the Biodiversity of Soil and Canopy Arthropods) expert network (ML, YB and Bruno Corbara) was working on a proposal to the NGO Pro-Natura International (hereafter "PNI", with OP as biodiversity officer) to carry out a biodiversity study along an altitudinal gradient in West Papua. The aim of this West Papuan project was to conduct a rapid inventory of a few tractable insect groups. It was planned to study 4 localities at different elevations, one of which would serve as a reference site close to an infrastructure facilitating research and subject to more extensive sampling (Figure 1). It was envisaged to collect arboreal ants, wasps and to include some of the monitoring protocols of the ForestGEO Arthropod Initiative to collect termites, butterflies and fruit-flies (Anderson-Teixeira *et al.* 2015; Lamarre *et al.* 2020).

The guiding idea for the scientific program was refined with VN during the annual congress of the Association of Tropical Biology and Conservation which took place in Bali in July 2010. This resulted in a new draft proposal for a project in Papua New Guinea in collaboration with the New Guinea Binatang Research Center (NGBRC). At that time, we were also carrying out a comprehensive analysis of the IBISCA-Panama project. This project had been conceived as a concerted effort between expert researchers focused on a variety of taxonomic groups representing different functions in the ecosystem. It combined a wide range of quantitative collection protocols focused on arthropods (Basset *et al.* 2007). Its results, subsequently published (Basset *et al.* 2012), allowed us for the first time to determine arthropod diversity in a lowland tropical forest in Panama and to demonstrate a relationship between tree and arthropod diversity. Another study, this time in Papua New Guinea, had shown that in lowland forests, insect composition does not change much from place to place, even for sites 500 kilometres apart (Novotny *et al.* 2007). The results of these two studies led to the main question of the nascent project, asking about the magnitude of additional diversity generated by elevation gradient starting from lowland rainforests. Papua New Guinea seemed a perfect place to investigate this question, as there were mountain ranges covered with undisturbed forest from the lowlands to the upper elevational limit of tree distribution (treeline). In addition, a ForestGEO site of 50 ha had just been created in Wanang, a lowland forest site (Vincent *et al.* 2015). Together with the local group of parataxonomists and para-ecologists of the NGBRC (Novotny 2010), we could envisage a large-scale project there. Two mountain systems were considered for the project: Finisterre Mountains (4150 m a.s.l.) and Mount Wilhelm (4509m a.s.l.), both with continuous forest cover from sea level to the treeline. Wanang was an obvious choice as a reference site in the lowlands with the additional benefit of the presence of a biological field station.

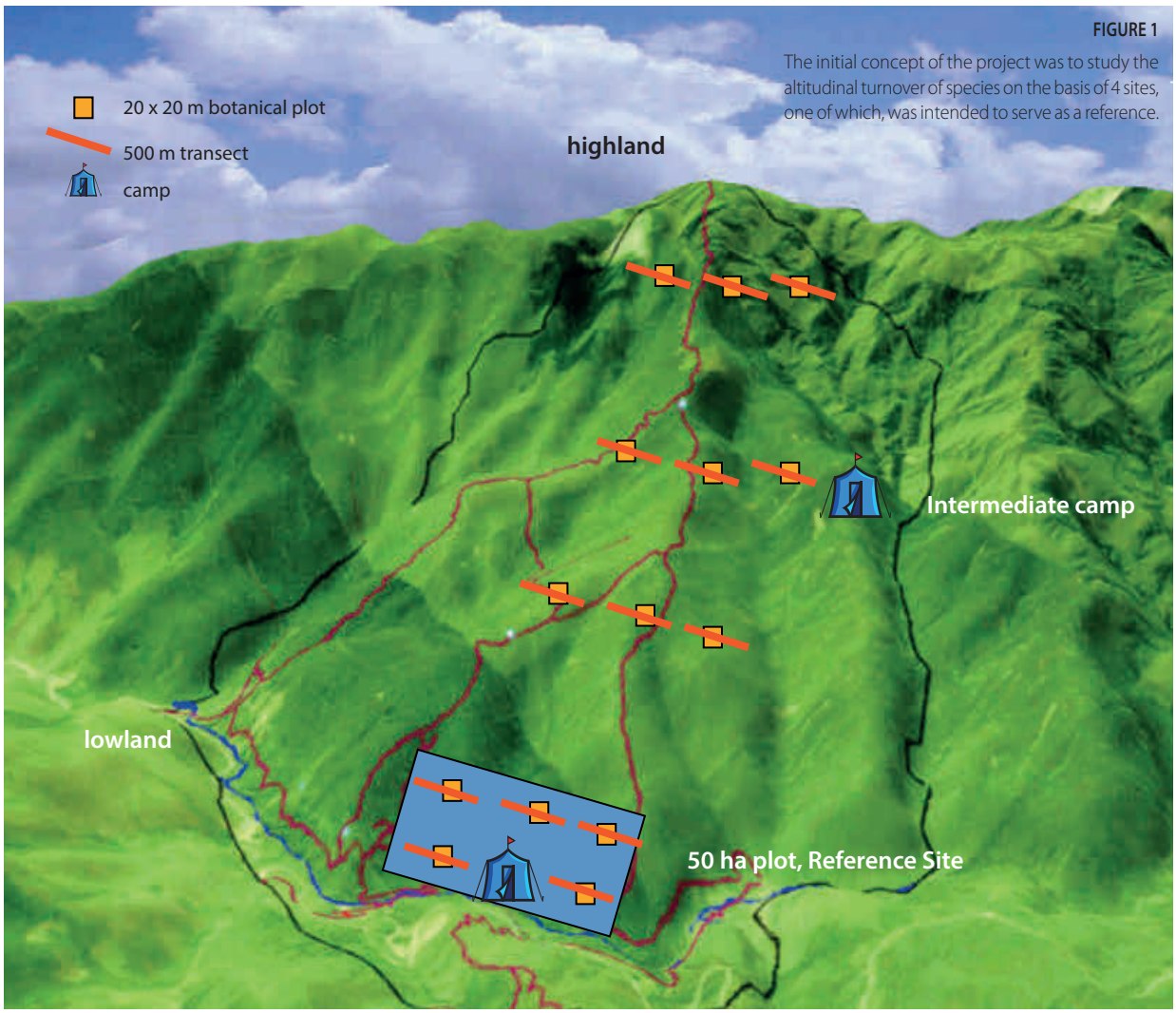


FIGURE 1
The initial concept of the project was to study the altitudinal turnover of species on the basis of 4 sites, one of which, was intended to serve as a reference.

STEP 2. FUNDRAISING

Fundraising by PNI began in the fall of 2010, in partnership with the Muséum national d'Histoire naturelle de Paris (MNHN), as part of the "Our Planet Reviewed" (OPR) program. This program, initiated by the two organizations mentioned above, had already conducted large-scale biodiversity inventories to Vanuatu (2006) and Mozambique-Madagascar (2009-2010) (Bouchet *et al.* 2009; Bouchet *et al.* 2011; Bouchet *et al.* 2012). "Our Planet Reviewed" aimed to gain new knowledge in the world's most biodiversity-rich but hitherto poorly explored regions, in both terrestrial and marine environments. Papua New Guinea was high on the list, being one the three largest forest basins in the world and also a biodiversity hotspot for marine life, lying in the middle of the coral triangle (Veron *et al.* 2011). Analogous to our terrestrial biodiversity inventory, a marine inventory project was then set up by Prof. Philippe Bouchet (MNHN) as an extension of his BIOPAPUA 2010 collection campaign. The two modules made up the joint project "Our Planet Reviewed – Papua New Guinea 2012-2014" (OPR-PNG). In less than two years the necessary funding, amounting to 1.2 million € in cash and 0.7 million € in kind (made available to the oceanographic vessel Alis by the French Research Institute for Development, IRD), had been raised. A separate fund-raising campaign was launched for the use of Canopy Balloons to collect samples from the treetops of the lowland site (Wanang). Donors are listed in the acknowledgements.

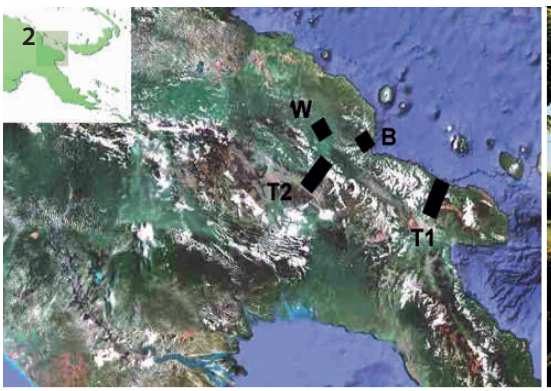
STEP 3. RECONNAISSANCE MISSIONS AND PARTNERSHIPS WITH LOCAL ACTORS

At the end of May 2011, together with Philippe Bouchet (MNHN), Ronan Kirsch (MNHN) and Claude Payri (IRD), we presented the project to the PNG authorities in Port Moresby. During these visits, we met with officials from the PNG National Research Institute (NRI), the Department of Environment and Conservation (DEC), the National Insect Collection of the PNG National Agriculture Research Institute (NARI) and the University of Papua New Guinea (UPNG). We then flew to Madang to visit the headquarters of the NGBRC, our in-country partner, and two of its field stations: Wanang and Yawan (Figure 2). The NGBRC is a biological research and conservation non-profit organization in Papua New Guinea established in 1997 by VN (Figure 3). It is one of the main training organizations for parataxonomists and paraecologists (Schmiedel *et al.* 2016). It is particularly active investigating the field of plant-insects food webs and has extensive reference collections on plants and insects (Figures 4, 5). Its Swire Research Station can be reached by road (Figure 6) then by foot with a stop at Wanang Village (Figures 7, 9). The Wanang Conservation Area is a local initiative of ten clans aimed at conserving 10,000 ha of primary forest in which the research station supporting these conservation actions is located (Novotny 2010; Novotny & Toko 2015). We met with local community leaders to explain our project, including the use of a canopy balloon that was shown in action in a film screened at night followed by the Hollywood blockbuster "Avatar" (Figure 8). At that time, we had selected the Finisterre Mountains for the altitudinal transect. We carried out a reconnaissance mission there by flying by light aircraft to the village of Kotet, near the Yawan research station, in direct proximity to the forest and supplied with electricity by solar panels (Figures 10-15). As in Wanang, we received a warm welcome from the local communities. The forest there was pristine as well.

Following our visit, an official partnership for OPR-PNG was signed between MNHN and PNI in July 2011, and a Memorandum of Understanding (MoU) between MNHN, IRD and UPNG in October 2011. In particular, this MoU included a commitment to collect samples only with the prior and informed consent of customary landowners and other stakeholders, to collect information and specimens only for academic and management purposes, to trace exported samples, to implement national and international regulations, and to participate in the training of Papua New Guinea students and scientists.

A major challenge when organizing a project in mountain terrain in Papua New Guinea is to obtain the consent of all owners to access their land along the elevation gradient. In November 2011, the situation deteriorated in the Finisterre Mountains due to disagreements between two communities. For this reason and because of the high cost of transporting food and equipment by plane, we decided to opt for the alternative option: Mount Wilhelm.

A one-week reconnaissance survey was then organized along Mount Wilhelm in March 2012 (Figures 16-26). Starting from Madang and passing through Goroka (1600 m a.s.l.) and Kundiawa (1500 m) we visited the forest sites and the possibilities of setting up camps between 2700 and 200 m. We were accompanied by two botanists, Jérôme Munzinger (IRD) and Kenneth Molem (NGBRC) (Figure 22). We reached by road to the surroundings of KeglSugl (2500 m). The road being then impassable due to frequent landslides, we had to continue on foot (Figure 18), visiting the abandoned camp of Bruno Sawmill (2700 m). We then spent the night in Konbogl (2400 m) in a thatched hut which was particularly smoky because it had no chimney (Figure 19). On the second day along the altitudinal transect, we reached Sinopas (2200 m). The forest between 2200 m and 2700 m corresponds to a mid-montane forest with majestic *Nothofagus* trees. The village of Sinopas has a beautiful mountain view and a school (Figures 20, 21). On the third day we reached the village of Bundi (1700 m). The path between these two stages was particularly tiring because it passed through a valley going down to 1200 m before going up again. The next day we had the opportunity to visit the lower montane forest with the presence of Fagaceae and Nothofagaceae (Figure 22). The next stage was a 1200 m descent leading us to 500 m, at Gabriel's house (Figure 23). From this place we went back up to visit, under pouring rain, the sites of 700 m and then 1200 m, where we spent the night (Figure 24). The forest at this altitude was a mixed lowland forest. On the last day we went back down, after crossing a river (Figure 25), to the village of Brahmin, passing through the village and the Kausi mixed alluvium forest at 200 m.


2
W
B
T2
T1


3


4


5


6

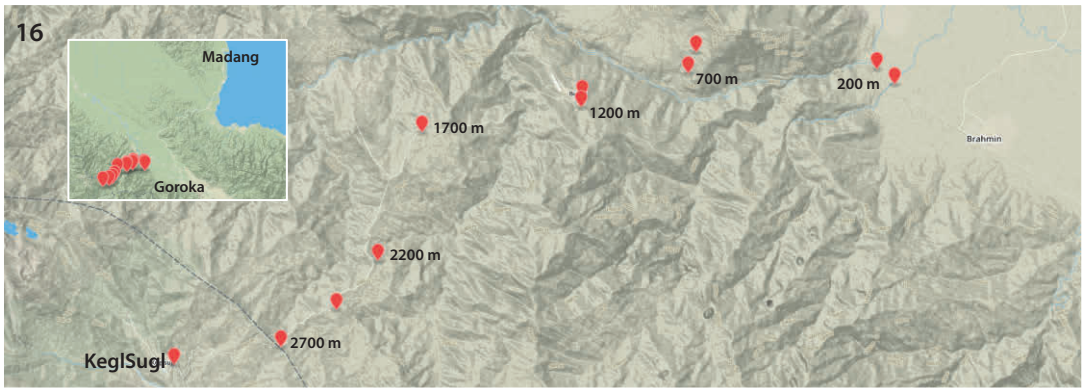

7


8


9
MANKING CONSERVATION
AREA
MOTTO

FIGURES 2-15

Step 3. First reconnaissance mission to the Finisterre Mountains in May 2011. **2**, Location of the different pre-selected sites: the PNG Binatang Research Center (BRC) headquarters, the altitudinal transect T1 along the Finisterres Mountains, its alternative, T2, along Mount Wilhelm and the lowland reference site, Wanang (W). **3, 4**, **5**, BRC laboratories. **4**, Discussion on the floristic composition of the sites with the botanist Georges Weiblen surrounded by Ronan Kirsch, Philippe Bouchet and Vojtech Novotny (from left to right). **5**, Entomological and botanical reference collections at the BRC. **6**, On the way to the lowland reference site, Wanang, difficult to access by road in rainy weather. **7**, Wanang village upstream of the Swire research station. **8**, Presentation of the project and previous achievements to the villager of Wanang. **9**, Entrance to the Wanang Conservation Area. **10**, Overview of the altitudinal path of this transect. **11**, fly over the mountains by light aircraft, the only means of resupplying high-altitude sites. **12**, Ubii Research Station built in the traditional village style, on stilts. **13**, Detail of the Ubii station, with solar panels as a power source and an antenna for radio communication. **14**, Light aircraft accessing the surroundings of the village of Toptet. **15**, The co-organizers of the project in full ascent (from left to right, VN, ML and OP). (Photos © Maurice Leponce).



FIGURES 16-19

Step 3 (continued). Reconnaissance mission to Mount Wilhelm in March 2012. **16**, Location of the different study sites, separated by altitudinal steps of 500 m and accessible from above from the village of KeglSugl. **17**, Arrival at the abandoned camp of Bruno sawmill (2700 m). **18**, Departure of the reconnaissance on foot, after having abandoned the vehicles, the road becoming impassable due to the landslides. **19**, Overnight stay in a hut in the village of Konbogl (2400 m).

FIGURES 20-26

Step 3 (continued). Reconnaissance mission to Mount Wilhelm in March 2012. **20**, **21**, arrival at the village of Sinopas (2200 m). **22**, The two botanists of the reconnaissance mission, Kenneth Molem and Jérôme Munzinger at 1700 m. **23**, Stage to Gabriel's House (500 m). **24**, Wet night at the camp at 1200 m. **25**, Crossing of the Ramu River (200 m). **26**, Return to Madang with Mount Wilhelm in the background. (Photos © Maurice Leponce).

STEP 4. CONSTITUTION OF THE TEAM OF FIELD RESEARCHERS

At the end of 2011, we gathered a scientific team comprising 21 international researchers from the organizing institutions (MNHN, IRD) and their partners (Royal Belgian Institute of Natural Sciences, NGBRC, IBISCA), seven scientists from New Guinea (from the PNG Forest Research Institute, the PNG National Agricultural Research Institute, the UPNG), 21 NGBRC para-ecologists and four students (see Table 2 in Leponce *et al.* (2016) for details). The team was set up in order to have a panel of experts covering the major groups of insects and plants collected. Each participant had to provide the organizers with a medical certificate and had to sign a registration form in which he or she agreed to abide by expedition rules (see Appendix 1).

STEP 5. OBTAINING RESEARCH AUTHORIZATIONS

The research proposal with the list of participants was submitted for approval to the National Research Institute (NRI) and the Department of Environment and Conservation (DEC) in November 2011 and accepted in May 2012. Research visas for foreign participants were obtained in September 2012. The consent of indigenous landowners at each site had been obtained during the reconnaissance trips described above.

STEP 6. PREPARATION OF THE MAIN SURVEY: PLOT DELINEATION, REFINEMENT OF THE PROTOCOLS, SHIPMENT OF EQUIPMENT AND CONSUMABLES, LOGISTICS

The botanical plots were established prior to the main expedition, between May and August 2012, and an inventory of all trees with a diameter of more than 5 cm was carried out by a team of NGBRC. Three botany plots per altitude, 20 x 20 m each, were set up for the total of eight altitudes (a total of 24 plots) on Mount Wilhelm. In June 2012, Roland Fourcaud, hired by PNI, did a reconnaissance mission in PNG to organize the logistics of the main survey, contacting food and accommodation providers and helicopter companies to prepare medical evacuation plans. The equipment and consumables were purchased from June 2012 locally or, if not available, ordered from abroad. Technical grade ethanol (400 litres), equipment and food for the camps were purchased locally. Laboratory equipment (12 microscopes, 2 power generators) and consumables (50,000 vials; 35,000 whirlpaks; entomological traps) were shipped from Europe. Additional equipment was posted from Belgium but lost when wrongly posted by the shipping company to Guinea (Africa) instead of Papua New Guinea.

In September 2012, YB and a team of paraecologists tested the main sampling protocols: Malaise traps, Flight Interception Traps, beating of vegetation, insecticide spray on the bark, and fruit fly traps at the Swire research station (Wanang) (Figure 27). Manuals for the use of equipment and sampling protocols have been drawn up for paraecologists, with the sequence of operations to be followed and the equipment to be provided. Inspection of trap catches in Wanang, in particular the abundance of various taxa present, made it possible to define focal taxa and the number of traps to be installed to ensure sound statistical analyses. This means that for a substantial portion of species, the sampling effort at each altitude had to be large enough to reliably detect them so that their absence at a particular altitude was genuine, and not merely the result of undersampling. This led to a five-fold increase in the number of Flight Interception Traps (capturing mainly beetles, a very diverse group) per elevation over the initially planned number. A solution had to be found quickly in order to be able to build 180 traps of this type with the materials available locally.

A timetable has been developed for collecting almost synchronously at 8 altitudes during the main survey (Table 3 in Leponce *et al.* (2016). Two types of permanent labels with unique codes for samples and vials were printed prior to the survey in the hope of minimizing specimen labelling problems afterwards (see figure 16 in Leponce *et al.* (2016)).

STEP 7. THE MAIN SURVEY

All the logistics of the operation were supervised by OP, assisted by Roland Fourcaud and the NGBRC team. This included booking transportation, lodging, porters, food and electricity for all eight camps (Figures 28, 29). To avoid overcrowding in the camps, the botanical and entomological teams were separate and their progress had been staggered over time (table 3 in Leponce *et al.* (2016)).

A team of para-ecologists, assisted by villagers, was stationed at each altitude (Figures 31-38). They had arrived a week before the expedition in order to build the camps. To avoid catching fleas and other undesirables we chose to sleep in hammocks. The villagers had never seen hammocks before and special huts had to be built to hang them up. We then realized quite quickly that it was not such a good idea, as the constructions were collapsing under the weight of the sleepers who, moreover, were freezing at high altitudes where temperatures are low.

The main survey along Mount Wilhelm took place between 13 October and 10 November. As explained in the foreword of this book, we unintentionally provoked an economic experiment in this period of time by creating a new currency that generated the immediate appearance of the concept of trade discount in the Highlands (Figure 30).

FIGURES 27-30

Main survey preparation and implementation. **27**, YB discussing the use of entomological traps with a group of para-ecologists. **28**, Coordination of the teams of para-ecologists before the sampling starts (from left to right: Joseph Kua, Legi Sam, Martin Mogia, VN, Bradley Gewa). **29**, Truck transporting material and food for the camps. **30**, PNGBRC receipts used to pay local salaries during the survey and exchangeable for cash at the end of it. These receipts soon became a local currency on Mount Wilhelm. (Photos © Maurice Leponce).

STEP 8. PRE-PROCESSING AND EXPORT OF COLLECTED SAMPLES

The samples collected during the inventory at Mount Wilhelm were pre-sorted at the Swire research station in Wanang immediately after field sampling had been completed (Figure 39, steps 7 & 8). During this period, the sampling protocol followed in the mountains was also applied at this lowland station. We refer to Volume 1 for a full description of the procedure followed. This pre-sorting of half a million specimens by 23 parataxonomists and two students, supervised by eight experts, was carried out in three weeks and provided a preliminary list of the sample contents. This list was submitted to the DEC, which, on this basis and after inspecting the samples, issued a permit to export the specimens. These specimens transited to Europe by ship in standardized drums for the transport of ethanol (UN1170) and arrived six months later at the MNHN in Paris at the same time as the samples collected during the marine inventory. Some experts present at the pre-sorting, such as Frode Ødegaard who inspected the beating samples, brought the samples directly back to their laboratory for further study. With regard to plants, voucher specimens were exported by IRD botanists in France while duplicates were deposited at the BRC and FRI herbariums.

STEP 9. PROCESSING AND DISTRIBUTION OF SPECIMENS BY TAXONOMIC SUPERVISORS

Upon completion of the pre-sorting of insect trap contents in PNG, samples were separated by major arthropod group (*e.g.*, orders) or by method (*e.g.*, beating, insecticide spray on bark) (Figure 39, step 8). The leader of each Taxonomic Working Group ("TWiG" according to the terminology of Janzen & Hallwachs (1994) then began to work on a finer separation into Families (Figure 39, step 9.1). He or she then contacted specialists in the different families from his or her network of experts. If they were interested in the identification of specimens and adhered to the general conditions specified in the listing form (see Appendix 2), the specimens were sent to them. A finer subdivision of the material was sometimes made by these specialists, redistributing the specimens to subfamily experts (Figure 39, step 9.2). For the Hymenoptera group alone, supervised by Claire Villemant (MNHN), 46 experts of 20 nationalities were involved (Figure 39). The subsequent species identification is a slow and complicated process given that the faunas studied are poorly known and, in some cases, require revisions before new species can be described. To continue with the example of Hymenoptera, specialists were found for about 10,000 of the 13,000 individuals pre-sorted in step 8. Eight years after the expedition about 70% of this material has been identified in 1570 species and 525 genera of which at least 337 species and 43 genera are new (Claire Villemant, pers. com.).

STEP 10. CENTRALIZATION OF DATA IN A COLLECTIVE DATABASE

Each expert of the family or subfamily then sorted the material down to the species or morphospecies level. This information is then sent back to the TWIG leaders who check the quality of the data and fill in a data entry template. This is also the time when the holotypes and paratypes are deposited in major museums. The data is then sent to the database administrator who merges and cleans all the data sheets to create a new version of the database where the specimens are identified at the morphospecies level. Some difficult groups were only sorted to family level and are entered as such in the database. We envision that the final database will contain information on the altitudinal distribution of about 200 plant, 2,500 Araneae, 10,000 Hymenoptera, 18,500 Diptera and over 100,000 Coleoptera specimens, to mention only the major groups.

FIGURES 31-38

31, Participants in projects starting from Betty's Lodge at 2800 m. **32-38**, teams stationed at different altitudes along Mount Wilhelm. (Photos © Maurice Leponce).

FIGURE 39

Overview of collection operations (step 7), pre-sorting and export (step 8), processing of samples by twig leaders down to the family level and distribution to family experts (step 9.1, photo © Juergen Schmidl), possibly redistributing material to sub-family specialists (step 9.2). All data, based on specimen identification and abundance (step 10, photo © Frode Ødegaard), is then encoded in a central database. (Photos © Maurice Leponce).

FIGURES 40-44

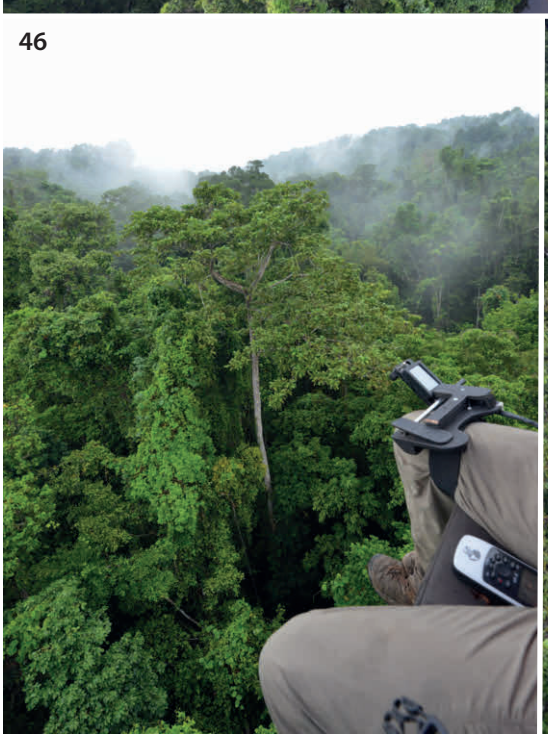
40, Collection of ant-plants from a *Canarium indicum* tree by means of the *Cinébulle* électrique (hot air balloon). **41**, Close-up of an ant plant. **42**, *Cinébulle* électrique, hot-air balloon propelled by an electric motor, in flight over Swire Research Station. **43**, Section of an ant plant. **44**, Colony of the ant *Anonychomyrma* sp. PK007 nesting in the ant-plant. (Photos © Maurice Leponce).

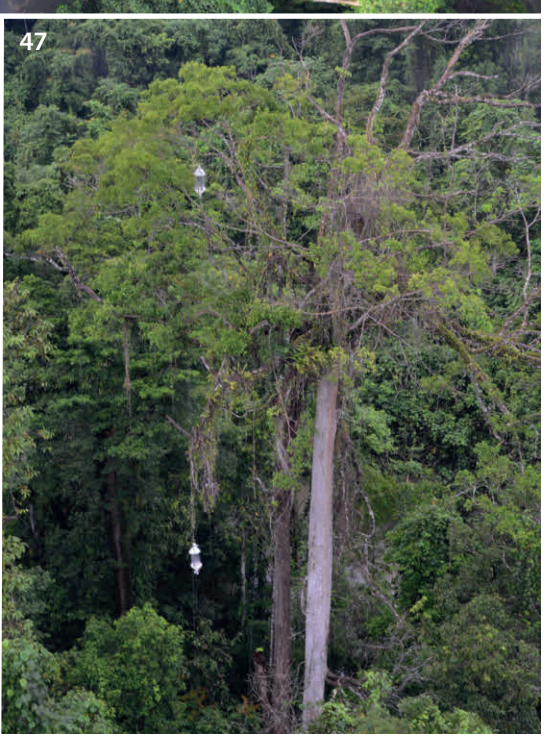
THE POST-SURVEY COMPLEMENTARY STUDIES

After the Mount Wilhelm main field work session in 2012, balloons surveys took place in Wanang early 2013. Canopy balloons were developed by the French pilot Dany Cleyet-Marrel. They are the only mobile device that allows a scientist to take samples directly from the surface of the canopy. In contrast, helicopters generate a strong downdraft with their propellers that prevents collection. Drones, which are smaller are difficult to handle between branches and are rarely equipped with prehensile arms. For safety reasons, climbers cannot move on thin branches or in tree species with brittle wood. The balloons were used to collect samples from treetops, in particular arboreal ants (Figure 50) and epiphytic myrmecophytes of the genera *Myrmecodia* and *Hydnophytum* (ant-plants) (Figures 40-44) (video: Leponce (2016). They also allowed the installation of insect polytraps in the trees from the ground to the tops of the trees and to map the structure of the canopy (Figures 45-47). A two-seater electrically propelled hot-air balloon ("Cinébulle électrique") was used in 2013 (Figures 40, 42, 46) and a single-seater helium balloon ("Bulle des Cimes") in 2014 (Figures 48-49). Additional collections were carried out in the project framework, notably by D. Bickel in 2013 and 2014 at the Wanang research station and at some study sites of the altitudinal transect on Mount Wilhelm. T. Robillard also collected in the Baitabag forest near Madang after the inventory of Mount Wilhelm in 2012.

SCIENTIFIC OUTPUT

The first volume of Insects of Mount Wilhelm (Robillard *et al.* 2016) contained 20 contributions dealing with diverse groups of arthropods, with the description of 144 species and 6 genera new to science. For 90 of them, the holotype comes from the expedition as well as the type species for all 6 new genera. The current volume contains 14 additional contributions with the description of 118 new species and 3 new genera. For 86 of them, the holotype comes from the expedition as well as the type species for 2 out of the 3 new genera. A total of 176 new species and 8 new genera are therefore described in both volumes and based solely on material from the expedition. It should be noted that the vast majority of these new species described belong to the Hymenoptera (about 75%). This only partly reflects the fact that this order is among the most species-rich and most certainly C. Villemant's formidable work in mobilising the Hymenoptera taxonomic community. It also gives an indirect insight into the vast amount of work that remains to be done for the other groups of arthropods collected during the expedition. In addition to the new species described in the two volumes of Insects of Mount Wilhelm, 43 other new species and 5 new genera are described in 19 other publications (Baker & Dransfield 2017; Belokobylskij & Villemant 2016; Belokobylskij 2013; Bickel 2019; Braet & Van Achterberg 2014; Butcher & Quicke 2014, 2015; Curletti 2017a, 2017b; Fernandez-Triana & Boudreault 2018; Gnezdilov *et al*. 2015; Khalaim & Villemant 2019; Kvifte & Bernal 2018; Maddison & Szűts 2019; Mata-Casanova *et al*. 2015; Peris-Felipo & Belokobylskij 2019; Szawaryn 2018; Szczpanski *et al.* 2018; Vicente *et al.* 2015) and one PhD thesis (Md Yusof 2020). In addition, two theses (Duvot 2013; Moses 2014) and 5 publications related to the project have been published so far in various academic journals. Five of these publications discuss the impact of the altitudinal gradient on species distribution (Chatelain *et al.* 2019; Colwell *et al.* 2016; Le Cesne *et al.* 2015; Orivel *et al.* 2018; Plowman *et al.* 2017) to which we can add two contributions to this volume also dealing with species distribution (Munzinger *et al.* 2020; Roisin 2020) and the contribution of Colinet *et al.*, 2016 in the first volume of Insects of Mount Wilhelm. Four publications on taxonomy are using or citing material from the expedition (Kurina *et al.* 2019; Shaverdo *et al.* 2016, 2019; Shaverdo & Balke 2019) to which we can add the contribution of Vargas & Azevedo (2016) to the first volume of Insects of Mount Wilhelm, 2 publications on ecology and behavioral studies (ter Hofstede *et al.* 2015; Klimes *et al.* 2018) and 4 publications on biogeography and phylogeny (Dong *et al*. 2018 Santos *et al.* 2018; Vicente *et al.* 2017; Zhang *et al.* 2018) give in-depth new knowledge on targeted groups.





FIGURES 45-47

45, Mapping of the canopy structure of the forest by flying over it with the Cinébulle. **46**, Approach of a *Canarium indicum* tree filled with ant plants. **47**, Polytraps, installed at different heights along the trunk, from the balloon. (Photos © Maurice Leponce).

FIGURES 48-50

48, Collecting canopy samples using a single-passenger helium balloon, the *Bulle des cimes*. **49**, View of the balloon from the ground. **50**, *Crematogaster* cf. *irritabilis* ant nest as seen from the balloon. (Photos © Maurice Leponce).

CONCLUSIONS. LESSONS LEARNED FOR FUTURE PROJECTS

Implementing a large-scale biotic inventory is a complex process (Leponce *et al.* 2010). Parallel to the design of the project, partnerships must be established, for example with museums, universities, NGOs. A local partner is essential to assist in the organization, including obtaining authorizations for the collection and export of the material. When presenting the project to the different stakeholders it is very important to underline the particular benefits: academic for scientists, societal for government authorities, in terms of sustainable development or conservation for NGOs, in terms of communication for the media, and a combination of these arguments for public or private sponsors.

The preparation of such a project takes at least two years. The completion of the results is spread over a much longer period, which can exceed a decade. For this reason, it is very important to combine a series of pilot projects with rapid reporting with larger projects such as a global synthesis of results or taxonomic revisions.

Various developments can improve the effectiveness of biodiversity inventories. For sample collections, it would be interesting to continue to develop methods of access to particular environments such as the canopy or subsoil, which are often neglected because of the complexity of reaching these habitats. For the processing of samples, it is essential to develop methods for tracing specimens as the number of sorting operations and the network of stakeholders (sorters, experts) is extensive. An effective system for labelling samples, both at the time of collection and also during sorting and identification, is essential. The system of two pre-printed labels tested in this project (one for the sample code and one for the vial code) created confusion among users. In the future a system with one label with a unique code is to be recommended.

A centralized tracking system, based on a website, will be developed for our future projects. It is important that all project participants are registered in a database. A user account will therefore be created for each of them. This account will only be active when they have read and accepted the "rules of the club" (appendices 1-2). From this account they will have access to all the information concerning the project and will be able to upload their data sets. It will thus be possible to communicate effectively with all stakeholders and to have a global vision of the project's progress. We will also endeavour to pre-sort the samples as accurately as possible in order to provide taxonomists with a list including the sample codes, and the abundance of the specimens sent to them.

Too often the financing of a biodiversity inventory stops at the financing of the field expedition. For the success of the project in a reasonable time frame, it is highly recommended to also provide funding to facilitate the very laborious sorting and identification operations. Training is also an important component, particularly of research technicians (*e.g.* para-taxonomists/ecologists) to assist principal investigators. For larger projects it is highly recommended to include MSc or PhD students, including from the host country, as an efficient combination of training and research. A pragmatic approach is also to focus on the study on informative yet tractable taxa. If the aim is a rapid detection of species in samples, metabarcoding combined with classical barcording presents itself as an alternative approach, in rapid evolution, compared to classical inventories (Hajibabaei *et al.* 2007; Liu *et al.* 2019).

One of the most important lessons of the project has also been that ecologists and taxonomists have different approaches to collecting and processing samples. As ecologists, we tried to place the insect traps randomly in the forest so that we could get an idea of the average density of insects and not favour particular environments. Taxonomists, on the other hand, use to place traps in flight corridors or places preferred by their target group. They also prefer to pool samples by site, which makes subsequent sorting of material less laborious, whereas ecologists are interested in the daily and fine spatial fluctuations in trap catch. Taxonomists are also not very interested in the abundance of individuals of each species, although this is essential data for an ecologist. An ecologist is interested in quantifying the diversity and distribution of organisms while a taxonomist is more interested in discovering new species. Clear communication about the objectives of the project, whether taxonomic or ecological in nature, is therefore essential for its success.

Ultimately, these biodiversity studies should lead to the conservation of habitats and, in this sense, those carried out along Mount Wilhelm have been successful since the local clans themselves decided to create a conservation area (see foreword) (Figure 51).

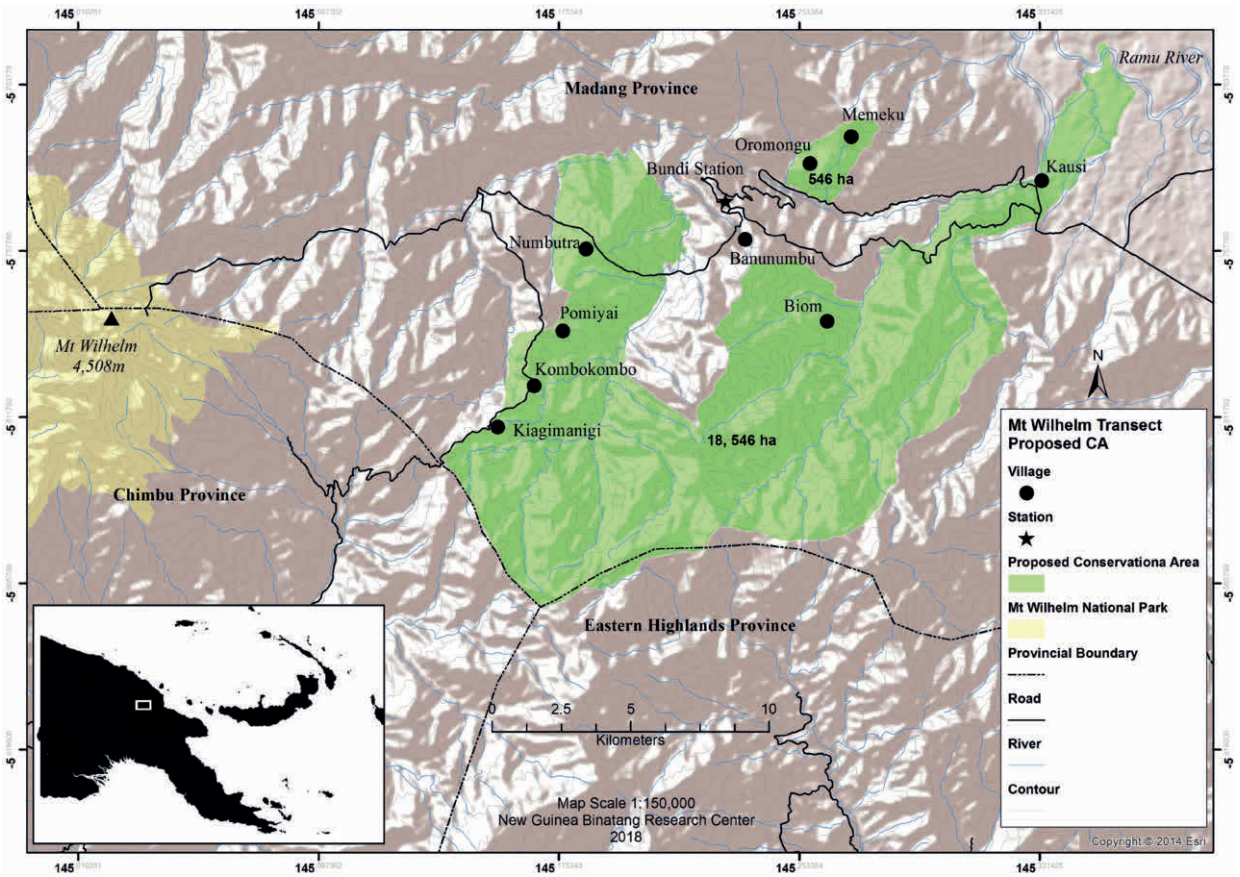


FIGURE 51

Delineation of the conservation area established spontaneously by landowners around the research transect. (Map by Jason Paliau).

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REFERENCES

ANDERSON-TEIXEIRA K. J., DAVIES S. J., BENNETT A. C., GONZALEZ-AKRE E. B., MULLER-LANDAU H. C., WRIGHT S. J., ABU SALIM K., ALMEYDA ZAMBRANO A. M., ALONSO A., BALTZER J. L., BASSET Y., BOURG N. A., BROADBENT E. N., BROCKELMAN W. Y., BUNYAVEJCHEWIN S., BURSLEM D. F., BUTT N., CAO M., CARDENAS D., CHUYONG G. B., CLAY K., CORDELL S., DATTARAJA H. S., DENG X., DETTO M., DU X., DUQUE A., ERIKSON D. L., EWANGO C. E., FISCHER G. A., FLETCHER C., FOSTER R. B., GIARDINA C. P., GILBERT G. S., GUNATILLEKE N., GUNATILLEKE S., HAO Z., HARGROVE W. W., HART T. B., HAU B. C., HE F., HOFFMAN F. M., HOWE R. W., HUBBELL S. P., INMAN-NARAHARI F. M., JANSEN P. A., JIANG M., JOHNSON D. J., KANZAKI M., KASSIM A. R., KENFACK D., KIBET S., KINNAIRD M. F., KORTE L., KRAL K., KUMAR J., LARSON A. J., LI Y., LI X., LIU S., LUM S. K., LUTZ J. A., MA K., MADDALENA D. M., MAKANA J. R., MALHI Y., MARTHEWS T., MAT SERUDIN R., MCMAHON S. M., MCSHEA W. J., MEMIAGHE H. R., MI X., MIZUNO T., MORECROFT M., MYERS J. A., NOVOTNY V., DE OLIVEIRA A. A., ONG P. S., ORWIG D. A., OSTERTAG R., DEN OUDEN J., PARKER G. G., PHILLIPS R. P., SACK L., SAINGE M. N., SANG W., SRI-NGERNYUANG K., SUKUMAR R., SUN I. F., SUNGPALEE W., SURESH H. S., TAN S., THOMAS S. C., THOMAS D. W., THOMPSON J., TURNER B. L., URIARTE M., VALENCIA R., VALLEJO M. I., VICENTINI A., VRSKA T., WANG X., WANG X., WEIBLEN G., WOLF A., XU H., YAP S. & ZIMMERMAN J. 2015 — CTFS-ForestGEO: a worldwide network monitoring forests in an era of global change. *Global Change Biology* 21(2): 528-549. https://doi.org/10.1111/gcb.12712

BAKER W. J. & DRANSFIELD J. 2017 — More new rattans from New Guinea and the Solomon Islands (*Calamus*, Arecaceae). Phytotaxa 305: 61-86. http://dx.doi.org/10.11646/phytotaxa.305.2.1

BASSET Y., CIZEK L., CUÉNOUD P., DIDHAM R. K., GUILHAUMON F., MISSA O., NOVOTNY V., ODEGAARD F., ROSLIN T., SCHMIDL J., TISHECHKIN A. K., WINCHESTER N. N., ROUBIK D. W., ABERLENC H. P., BAIL J., BARRIOS H., BRIDLE J. R., CASTANO-MENESES G., CORBARA B., CURLETTI G., DUARTE DA ROCHA W., DE BAKKER D., DELABIE J. H., DEJEAN A., FAGAN L. L., FLOREN A., KITCHING R. L., MEDIANERO E., MILLER S. E., GAMA DE OLIVEIRA E., ORIVEL J., POLLET M., RAPP M., RIBEIRO S. P., ROISIN Y., SCHMIDT J. B., SORENSEN L. & LEPONCE M. 2012 — Arthropod diversity in a tropical forest. *Science* 338(6113): 1481-1484. https://doi.org/10.1126/science.1226727

BASSET Y., CORBARA B., BARRIOS H., CUÉNOUD P., LEPONCE M., ABERLENC H. P., BAIL J., BITO D., BRIDLE J. R., CASTAÑO-MENESES G., CIZEK L., CORNEJO A., CURLETTI G., DELABIE J. H. C., DEJEAN A., DIDHAM R. K., DUFRÊNE M., FAGAN L. L., FLOREN A., FRAME D., HALLÉ F., HARDY O. J., HERNANDEZ A., KITCHING R. L., LEWINSOHN T. M., LEWIS O. T., MANUMBOR M., MEDIANERO E., MISSA O., MITCHELL A. M., MOGIA M., NOVOTNY V., ØDEGAARD F., GAMA DE OLIVEIRA E., ORIVEL J., OZANNE C. M. P., PASCAL O., PINZÓN S., RAPP M., RIBEIRO S. P., ROISIN Y., ROSLIN T., ROUBIK D. W., SAMANIEGO M., SCHMIDL J., SØRENSEN L. L., TISHECHKIN A., VAN OSSELAER C. & WINCHESTER N. N. 2007 — IBISCA-Panama, a large-scale study of arthropod beta-diversity and vertical stratification in a lowland rainforest: rationale, study sites and field protocols. *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Entomologie* 77: 39-69.

BELOKOBYLSKIJ S.A. 2013 — A new species of the genus *Asiaontsira* Belokobylskij, Tang et Chen, 2013 (Hymenoptera: Braconidae: Doryctinae) from Papua New Guinea. *Euroasian Entomological Journal* Евразиатский энтомол. журнал 15. Прил. 1: 20-23.

BELOKOBYLSKIJ S. A. & VILLEMANT C. 2016 — A new genus of the tribe Pambolini (Hymenoptera: Braconidae: Exothecinae) from the Papua New Guinea with a key to the World genera. *Zootaxa* 4098(2): 383-391. https://doi.org/10.11646/zootaxa.4098.2.10

BICKEL D. J. 2019 — The Amblypsilopus amnoni and megastoma groups in New Guinea (Diptera: Dolichopodidae: Sciapodinae). *Israel Journal of Entomology* 49(2): 195-214. https://doi.org/10.5281/zenodo.3522860

BICKEL D. J. & MCEVEY S. 2014 — Diptera diversity on Mt Wilhelm, Papua New Guinea: faunal change with elevation, *in* DORCHIN N., KOTRBA M., MENGUAL X. & MENZEL F. (eds), 8th International Congress of Dipterology, Potsdam 2014. Abstract Vol. AMPYX-Verlag, Halle (Saale), p. 39.

BOUCHET P., LE GUYADER H. & PASCAL O. 2009 — The SANTO 2006 Global Biodiversity Survey: an attempt to reconcile the pace of taxonomy and conservation. *Zoosystema* (3): 401-406.

BOUCHET P., LE GUYADER H. & PASCAL O. 2011 — The Natural History of Santo. MNHN, Paris; IRD , Marseille; PNI, Paris (*Patrimoines naturels*). 70: 572 p.

BOUCHET P., LE GUYADER H. & PASCAL O. 2012 — The altruism of biodiversity exploration expeditions. *Zoosystema* 34(2): 193-202.

BRAET Y. & VAN ACHTERBERG C. 2014 — A new genus and two new species of Alysiinae (Hymenoptera: Braconidae) from Papua New Guinea. *Zootaxa*, 3869(2): 189-197. https://doi.org/10.11646/zootaxa.3869.2.9

BUTCHER B. A. & QUICKE D. L. 2014 — Three new species of Kerevata (Braconidae: Rogadinae: Clinocentrini) from mainland Papua New Guinea. *Zootaxa* (3811): 338-346. https://doi.org/10.11646/zootaxa.3811.3.4

BUTCHER B. A. & QUICKE D. L. J. 2015 — A remarkable new genus and species of Rogadinae (Hymenoptera: Braconidae) of uncertain tribal placement, from Papua New Guinea, resembling Betylobraconini stat. nov. *Journal of Natural History*, 49(33-34), 2045-2054. doi:10.1080/00222933.2015.1009405

CHATELAIN P., LE CESNE M., ELIAS M., GUILBERT E. & SOULIER-PERKINS A. 2019 — Elevational filtering and the evolution of planthoppers (Hemiptera, Fulgoromorpha) in Papua New Guinea. *Biotropica* 52(2): 313-322. https://doi.org/10.1111/btp.12710

COLINET C., EXBRAYAT M., ROBILLARD T. & LEGENDRE F. 2016 — Species richness and composition in cockroaches (Dictyoptera: Blattodea) along an elevational gradient in Papua New Guinea, *in* ROBILLARD T., LEGENDRE F., VILLEMANT C. & LEPONCE M. (eds), Insects of Mount Wilhelm, Papua New Guinea. Muséum national d'Histoire naturelle, Paris: 129-140 (Mémoires du Muséum national d'Histoire naturelle ; 209). ISBN: 978-2-85653-784-8.

COLWELL R. K., GOTELLI N. J., ASHTON L. A., BECK J., BREHM G., FAYLE T. M., FIEDLER K., FORISTER M. L., KESSLER M., KITCHING R. L., KLIMES P., KLUGE J., LONGINO J. T., MAUNSELL S. C., MCCAIN C. M., MOSES J., NOBEN S., SAM K., SAM L., SHAPIRO A. M., WANG X. & NOVOTNY V. 2016 — Midpoint attractors and species richness: Modelling the interaction between environmental drivers and geometric constraints. *Ecology Letters* 19(9): 1009-1022. https://doi.org/10.1111/ele.12640

CURLETTI G. 2017a — Supplement to the Contribution to the Genus Agrilus Curtis, 1825 (Coleoptera Buprestidae) based on the expedition «Our Planet Reviewed» in Papua New Guinea. *Giornale Italiano di Entomologia* 14(62): 651-654.

CURLETTI G. 2017b — Updates on the Agrilofauna of Papua New Guinea (Coleoptera, Buprestidae). *Giornale Italiano di Entomologia* 14(62): 691-696.

DONG J. KERGOAT, G. J., VICENTE N., RAHMADI C., XU S., ROBILLARD T. (2018) — Biogeographic patterns and diversification dynamics of the genus *Cardiodactylus* Saussure (Orthoptera, Grylloidea, Eneopterinae) in Southeast Asia. *Molecular Phylogenetics and Evolution* 129:1-14. doi: 10.1016/j.ympev.2018.06.001.

DUVOT G. 2013 — Étude de la répartition altitudinale des Hyménoptères sur le mont Wilhelm en Papouasie-Nouvelle Guinée. PhD Dissertation. Université Pierre et Marie Curie, Paris.

FERNANDEZ-TRIANA J. & BOUDREAULT C. 2018 — Seventeen new genera of microgastrine parasitoid wasps (Hymenoptera, Braconidae) from tropical areas of the world. *Journal of Hymenoptera research* 64: 25-140. https://doi.org/10.3897/jhr.64.25453

GNEZDILOV V. M., CESNE M. L., SOULIER-PERKINS A. & BOURGOIN T. 2015 — New Guinean Issidae: description of new taxa in a poorly known island fauna (Hemiptera, Fulgoroidea). Zootaxa 3904(1): 82-94. https://doi.org/10.11646/zootaxa.3904.1.4

HAJIBABAEI M., SINGER G. A. C., HEBERT P. D. N. & HICKEY D. A. 2007 — DNA barcoding: how it complements taxonomy, molecular phylogenetics and population genetics. *Trends in Genetics* 23(4): 167-172. https://doi.org/10.1016/j.tig.2007.02.001

HAMILTON A. J., BASSET Y., BENKE K. K., GRIMBACHER P. S., MILLER S. E., NOVOTNY V., SAMUELSON G. A., STORK N. E., WEIBLEN G. D. & YEN J. D. 2010 — Quantifying uncertainty in estimation of tropical arthropod species richness. *American Naturalist* 176(1): 90-95. https://doi.org/10.1086/652998

HAMILTON A. J., NOVOTNY V., WATERS E. K., BASSET Y., BENKE K. K., GRIMBACHER P. S., MILLER S. E., SAMUELSON G. A., WEIBLEN G. D., YEN J. D. & STORK N. E. 2013 — Estimating global arthropod species richness: refining probabilistic models using probability bounds analysis. *Oecologia* 171(2): 357-365. https://doi.org/10.1007/s00442-012-2434-5

JANZEN D. H. & HALLWACHS W. 1994 — All Taxa Biodiversity Inventory (ATBI) of Terrestrial Systems: A Generic Protocol for Preparing Wildland Biodiversity for Non-Damaging Use., *Report of a National Science Foundation Workshop, 16-18 April 1993, Philadelphia, Pennsylvania.*

KLIMES P., BOROVANSKA M., PLOWMAN N. S. & LEPONCE M. 2018. — How common is trophobiosis with hoppers (Hemiptera: Auchenorrhyncha) inside ant nests (Hymenoptera: Formicidae)? Novel interactions from New Guinea and a worldwide overview. *Myrmecological News* 26: 31-45.

JOHNS R. J. 1982 — Plant zonation, *in* GRESSITT J. L. (ed.). *Biogeography and Ecology of New Guinea*. Junk, The Hague: 309-331.

KHALAIM A. I. & VILLEMANT C. 2019 — Tersilochinae (Hymenoptera: Ichneumonidae) of Papua New Guinea: Genera Allophrys Förster and Probles Förster. *Zootaxa* 4544(2): 235-250. https://doi.org/10.11646/zootaxa.4544.2.5

KURINA O., HIPPA H. & DE SOUZA AMORIM D. 2019 — Notes on manota williston (Diptera: Mycetophilidae) from Australia and Papua New Guinea, with description of two new species. *Zootaxa* 4555(3): 385-395. https://doi.org/10.11646/zootaxa.4555.3.7

KVIFTE G. M. & BERNAL X. E. 2018 — A new species of frog-biting midge from Papua New Guinea with a key to the described Corethrellidae of the Australopapuan region (Diptera, Corethrellidae, Corethrella). *ZooKeys* 2018(795): 39-48. https://doi.org/10.3897/zookeys.795.28543

LAMARRE G. P. A., FAYLE T. M., SEGAR S. T., LAIRD-HOPKINS B., NAKAMURA A., SOUTO-VILARÓS D., WATANABE S. & BASSET Y. 2020 — Monitoring tropical insects in the 21st century. *Advances in Ecological Research in* DUMBRELL A. J., TURNER E. C. & FAYLE T. M. (eds). *Advances in Ecological Research*. Elsevier, Cambridge, MA: 295-330. https://doi.org/10.1016/bs.aecr.2020.01.004

LE CESNE M., WILSON S. W. & SOULIER-PERKINS A. 2015 — Elevational gradient of Hemiptera (Heteroptera, Auchenorrhyncha) on a tropical mountain in Papua New Guinea. *PeerJ* 3: e978. https://doi.org/10.7717/peerj.978

LEPONCE M. 2016 — In The Treetops of Papua New Guinea.[Video]. Retrieved February 23, 2020, from https://www.youtube.com/watch?v=04h2FLb1HtA https://www.youtube.com/watch?v=04h2FLb1HtA and https://vimeo.com/156710960.

LEPONCE M., MEYER C., HÄUSER C., BOUCHET P., DELABIE J., WEIGT L. & BASSET Y. 2010 — Challenges and solutions for planning and implementing large-scale biotic inventories, *in* EYMANN J., DEGREEF J., HÄUSER C., MONJE J. C., SAMYN Y. & VANDENSPIEGEL D. (eds). *Manual on field recording techniques and protocols for All Taxa Biodiversity Inventories and Monitoring*. ABC taxa, 8 (part 1): 18-48.

LEPONCE M., NOVOTNY V., PASCAL O., ROBILLARD T., LEGENDRE F., VILLEMANT C., MUNZINGER J., MOLINO J.-F., DREW R., ODEGAARD F., SCHMIDL J., TISHECHKIN A., SAM K., BICKEL D., DAHL C., DAMAS K., FAYLE T. M., GEWA B., JACQUEMIN J., KELTIM M., KLIMES P., KOANE B., KUA J., MANTILLERI A., MOGIA M., MOLEM K., MOSES J., NOWATUO H., ORIVEL J., PINTAUD J.-C., ROISIN Y., SAM L., SIKI B., SOLDATI L., SOULIER-PERKINS A., TULAI S., YOMBAI J., WARDHAUGH C. & BASSET Y. 2016 — Land module of Our Planet Reviewed - Papua New Guinea: aims, methods and first taxonomical results, *in* ROBILLARD T., LEGENDRE F., VILLEMANT C. & LEPONCE M. (eds). Insects of Mount Wilhelm, Papua New Guinea. *Mémoires du Muséum national d'Histoire naturelle*, 209: 13-48.

LIU M., CLARK L. J., BAKER S. C., JORDAN G. J. & BURRIDGE C. P. 2019 — A practical guide to DNA metabarcoding for entomological ecologists. *Ecological Entomology*. https://doi.org/10.1111/een.12831

MADDISON W. P. & SZUTS T. 2019 — Myrmarachnine jumping spiders of the new subtribe Levieina from Papua New Guinea (Araneae, Salticidae, Myrmarachnini). *ZooKeys* 842: 85-112. https://doi.org/10.3897/zookeys.842.32970

MCEVEY S. 2014 — The Drosophilidae of New Guinea, *in* DORCHIN N., KOTRBA M., MENGUAL X. & MENZEL F. (eds) 8th International Congress of Dipterology, Potsdam 2014. Abstract Vol. AMPYX-Verlag, Halle (Saale), p. 215.

MD YUSOF N. A. 2020 — A review of the stilt-legged fly subfamily Eurybatinae (Diptera: Micropezidae). Thesis, University of Guelph, 141 pp. http://hdl.handle.net/10214/18040

MATA-CASANOVA N., SELFA J. & PUJADE-VILLAR J. 2015 — Current knowledge of the subfamily Anacharitinae (Hymenoptera: Figitidae) in the Australasian region. *Austral Entomology* 54, 438–444.

MOSES J. 2014 — A Tropical Elevational Gradient in Ants (Hymenoptera: Formicidae): Diversity Patterns, Food Preferences and Nutrient Redistribution Rates on Mt Wilhelm, Papua New Guinea. MSc Thesis. PhD Dissertation. University of Papua New Guinea.

NOVOTNY V. 2010 — Rain Forest Conservation in a Tribal World: Why Forest Dwellers Prefer Loggers to Conservationists. *Biotropica* 42(5): 546-549. https://doi.org/10.1111/j.1744-7429.2010.00658.x

NOVOTNY V., BASSET Y., MILLER S. E., WEIBLEN G. D., BREMER B., CIZEL L. & DROZD P. 2002 — Low host specificity of herbivorous insects in a tropical forest., *Nature* 416: 841-844. https://doi.org/10.1038/416841a

NOVOTNY V., MILLER S. E., HULCR J., DREW R. A. I., BASSET Y., JANDA M., SETLIFF G. P., DARROW K., STEWART A. J. A., AUGA J., ISUA B., MOLEM K., MANUMBOR M., TAMTIAI E., MOGIA M. & WEIBLEN G. D. 2007 — Low beta diversity of herbivorous insects in tropical forests. *Nature* 448 (7154): 692-695. https://doi.org/10.1038/nature06021

NOVOTNY V. & TOKO P. 2015 — Ecological research in Papua New Guinean rainforests: insects, plants and people, *in* BRYAN J. E. & SHEARMAN P. L. (eds). *The State of the Forests of Papua New Guinea 2014: Measuring change over the period 2002-2014*. University of Papua New Guinea, Port Moresby: 71-85.

ORIVEL J., KLIMES P., NOVOTNY V. & LEPONCE M. 2018 — Resource use and food preferences in understory ant communities along a complete elevational gradient in Papua New Guinea. *Biotropica* 50(4): 641-648. https://doi.org/10.1111/btp.12539

PERIS-FELIPO F. J. & BELOKOBYLSKIJ S. A. 2019 — New Australasian species from subgenus *Eusynaldis* of the genus *Aspilota* Foerster 1863 (Hymenoptera, Braconidae, Alysiinae) with a key to World species. *Bulletin of Insectology* 72 (1): 21-27.

PLOWMAN N. S., HOOD A. S., MOSES J., REDMOND C., NOVOTNY V., KLIMES P. & FAYLE T. M. 2017 — Network reorganization and breakdown of an ant-plant protection mutualism with elevation. *Proceeding of the Royal Society B. Biological Sciences* 284: 20162564. https://doi.org/10.1098/rspb.2016.2564

ROBILLARD T., LEGENDRE F., VILLEMANT C. & LEPONCE M. 2016 — Insects of Mount Wilhelm, Papua New Guinea. *Mémoires du Muséum national d'Histoire naturelle*, Paris. 209: 573 p.

SANTOS B. F., ALVARADO M., SÄÄKSJÄRVI I. E., VAN NOORT S., VILLEMANT C. & BRADY S. G. 2018 — Molecular phylogeny of Ateleutinae (Hymenoptera: Ichneumonidae): systematics and biogeography of a widespread parasitoid wasp lineage. *Zoological Journal of the Linnean Society* 185(4): 1057-1078. https://doi.org/10.1093/zoolinnean/zly072

SCHMIEDEL U., ARAYA Y., BORTOLOTTO M. I., BOECKENHOFF L., HALLWACHS W., JANZEN D., KOLIPAKA S. S., NOVOTNY V., PALM M., PARFONDRY M., SMANIS A. & TOKO P. 2016 — Contributions of paraecologists and parataxonomists to research, conservation, and social development. *Conservation biology : the journal of the Society for Conservation Biology* 30(3): 506-519. https://doi.org/10.1111/cobi.12661

SHAVERDO H.V. & BALKE M. 2019 — A new species of the Exocelina ekari group and new faunistic data on 12 species of Exocelina BROUN, 1886 from New Guinea (Coleoptera: Dytiscidae). *Koleopterologische Rundschau* 89: 1-10.

SHAVERDO H., SAGATA K., BALKE M. 2016 — Taxonomic revision of New Guinea diving beetles of the *Exocelina danae* group, with the description of ten new species (Coleoptera, Dytiscidae, Copelatinae). *ZooKeys* 619: 45-102. doi: 10.3897/zookeys.619.9951

SHAVERDO H., SURBAKTI S., WARIKAR E. L., SAGATA K., & BALKE M. 2019 — Nine new species groups, 15 new species, and one new subspecies of New Guinea diving beetles of the genus *Exocelina* Broun, 1886 (Coleoptera, Dytiscidae, Copelatinae). *ZooKeys* 878: 73-143. https://doi.org/10.3897/zookeys.878.37403

STORK N. E. 2018 — How Many Species of Insects and Other Terrestrial Arthropods Are There on Earth? *Annual Review of Entomology* 63(1): 31-45. https://doi.org/10.1146/annurev-ento-020117-043348

SZAWARYN K. 2018 — Missing geographic link: Minute lady beetles (Coleoptera: Coccinellidae: Microweiseinae) from Mount Wilhelm, New Guinea. *Acta Entomologica Musei Nationalis Pragae* 58(1): 227-236. https://doi.org/10.2478/aemnp-2018-0019

SZCZPANSKI W. T., VONDRACEK D., SEIDE M., WARDHAUGH C. & FICACEK M. 2018 — High diversity of Cetiocyon beetles (Coleoptera: Hydrophilidae) along an elevational gradient on Mt. Wilhelm, New Guinea, with new records from the Bird's Head Peninsula. *Arthropod Systematics and Phylogeny* 76(2): 323-347. https://www.researchgate.net/publication/328278215

TER HOFSTEDE H. M., SCHÖNEICH S., ROBILLARD T., HEDWIG B. 2015. — Evolution of a Communication System by Sensory Exploitation of Startle Behavior. *Current Biology* 25: 1-8. http://dx.doi.org/10.1016/j.cub.2015.10.064

VARGAS J. M. & AZEVEDO C. O. 2016 — Discovery of the male of *Galodoxa* nagy (Hymenoptera: bethylidae), with emended generic diagnosis, *in* ROBILLARD T., LEGENDRE F., VILLEMANT C. & LEPONCE M. (eds), Insects of Mount Wilhelm, Papua New Guinea. Muséum national d'Histoire naturelle, Paris: 393-406 (Mémoires du Muséum national d'Histoire naturelle ; 209).

VERON J. E. N., DEVANTIER L. M., TURAK E., GREEN A. L., KININMONTH S., STAFFORD-SMITH M. & PETERSON N. 2011 — The Coral Triangle. *Coral Reefs: An Ecosystem in Transition* 47-55. https://doi.org/10.1007/978-94-007-0114-4_5

VICENTE N. M., OLIVERO P., LAFOND A., DONG J. & ROBILLARD T. 2015 — Gnominthus gen. nov., a new genus of crickets endemic to Papua New Guinea with novel acoustic and behavioral diversity (Insecta, Orthoptera, Gryllidae, Eneopterinae). *Zoologischer Anzeiger - A Journal of Comparative Zoology* 258: 82-91. https://doi.org/10.1016/j.jcz.2015.06.005

VICENTE N., KERGOAT G. J., DONG J., YOTOKO K., LEGENDRE F., NATTIER R. & ROBILLARD T. 2017 — In and out of the Neotropics: historical biogeography of Eneopterinae crickets. Journal of Biogeography. http://wileyonlinelibrary.com/journal/jbi doi:10.1111/jbi.13026

VINCENT J. B., HENNING B., SAULEI S., SOSANIKA G. & WEIBLEN G. D. 2015 — Forest carbon in lowland Papua New Guinea: Local variation and the importance of small trees. *Austral Ecology* 40(2): 151-159. https://doi.org/10.1111/aec.12187

ZHANG Y. M., STIGENBERG J., MEYER J. H., & SHARANOWSKI B. J. 2018 — Multilocusphylogeny of the parasitic wasps in the tribe euphorini (hymenoptera: braconidae) withrevised generic classifications. PeerJ 6: e4783 https://doi.org/10.7717/peerj.4783

APPENDIX 1

Registration form for field participants.

Expédition Papouasie Nouvelle-Guinée 2012-2013

Co-organisateurs :
- **Muséum National d'Histoire Naturelle**
- **Pro-Natura International**
- **Institut de Recherche pour le Développement**

Partenaires en Papouasie Nouvelle-Guinée:
- **University of Papua New Guinea (UPNG)**
- **The Binatang Research Center (BRC)**
- **The Divine Word University (DWU)**

FICHE PARTICIPANT et/ou VISITEUR

CONDITIONS GÉNÉRALES

Je soussigné(e),

……

Adresse personnelle :

……

……

Organisme ou société :

……

Siège (adresse) :

……

……

Nationalité : ……..

Personne à prévenir en cas d'accident (nom, téléphone, email)

……

Intervenant sur la Mission "Papouasie Nouvelle-Guinée 2012-2013" en qualité de :
Participant scientifique / Média / équipe technique / visiteur
(rayer les mentions inutiles)

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.
Fait à .....

le : ..... en deux exemplaires
(dont un à conserver par le participant)
Signature et mention :

(mention manuscrite : "Lu et approuvé, bon pour acceptation des Conditions générales ci-jointes")

Papua New Guinea Expedition, 2012-2013

Co-organizers:
- **Muséum National d'Histoire Naturelle**
- **Pro-Natura International**
- **Institut de Recherche pour le Développement**

Local counterparts :
- **University of Papua New Guinea (UPNG)**
- **The Binatang Research Center (BRC)**
- **The Divine Word University (DWU)**

PARTICIPANT and/or VISITOR FORM

GENERAL CONDITIONS

I, the undersigned (Print name),

……

Personal address:

……

……

Institution or company:

……

Institution/Company address:

……

……

Nationality: .....

Person to be contacted in case of accident (name, telephone, email address)

……

Participating in the "Papua New Guinea 2012-2013" Expedition as a :
Scientific Participant / media / logistical staff / visitor
(circle one)

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.

Prepared in duplicate at (place)……
(one to be kept by the participant)
Date:……..

Signature:

(Please write in your own hand: "I accept the General Conditions" and sign)

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 Papouasie Nouvelle-Guinée, 2012-2013».	1 -The present General Conditions apply to all individuals and institutions or their representatives who participate in the « Our Planet Reviewed – Papua New Guinea 2012-2013 expedition».
2 - Un permis collectif de recherche et de collecte a été délivré par les autorités de Papouasie Nouvelle-Guinée pour l'expédition PAPUA NIUGINI 2012-2013. Pour satisfaire aux obligations découlant des accords signés par les organisateurs, le participant s'engage à n'accéder au terrain et prélever des échantillons qu'après l'accord préalable des propriétaires coutumiers et autres ayant-droits; il 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 exclus les finalités commerciales et industrielles.	2 – A research and collecting permit has been issued by the authorities of Papua New Guinea collectively for the PAPUA NIUGINI 2012-2013 expedition. To comply with the agreements signed by the organizers, the Participant/Visitor commits to access sites and collect samples only after prior informed consent of the customary landowners and other stakeholders, and 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) indispensables ou nécessaires pour l'immuniser contre les maladies tropicales. Pour la composante terrestre, il devra dans la mesure du possible être pourvu d'une trousse de première nécessité et de ses médicaments personnels en cas de traitement car l'assistance médicale sera limitée sur la mission (un médecin accompagnera les équipes au Mont Wilhelm, mais la station de recherche de Wanang ne dispose pas d'encadrement médical).	3 - Before accessing any site, the Participant/Visitor must take all measures to prevent tropical diseases (especially ensuring that vaccinations are valid and up to date in their International Certificate of Vaccination). For the terrestrial component 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 during the Mt Wilhelm patrol, but not for the Wanang party).
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 Sarah Pezet pezet@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 prenne en charge les victimes qu'à partir d'un aéroport international, (Port Moresby dans le cas de la Papouasie Nouvelle-Guinée). 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 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 terme de délais ou de moyens matériels.	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 emergency case. This information must be provided to: Olivier Pascal oli.pascal@gmail.com for those participating in the terrestrial component and to Sarah Pezet pezet@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 (Port Moresby for Papua New Guinea). 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. 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 – 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.	5 – The Participant/Visitor commits to follow the rules and regulations laid down by the representative of the Organizers.
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 Papouasie Nouvelle-Guinée. 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.	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 Papua New Guinea. 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 – 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.	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 - 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'expéditionelle-même sous la dénomination "**Expédition Muséum National d'Histoire Naturelle de Paris / Pro-Natura International / Institut de Recherche pour le Développement – La Planète Revisitée, Papouasie Nouvelle Guinée 2012-2013**". 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 Planère Revisitée – Expédition MNHN / PNI / IRD Papouasie Nouvelle -Guinée 2012-2013**».	8 - 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 / Institut de Recherche pour le Développement – 'Our Planet Reviewed' Initiative, Papua New Guinea 2012-2103 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.

APPENDIX 2

Registration form for taxonomists

Our Planet Reviewed – Papua New Guinea

Principal Investigators (PIs): Maurice Leponce (Maurice.Leponce@naturalsciences.be) and Vojtech Novotny (novotny@entu.cas.cz)

Lead organisations: Pro-Natura International, the National Museum of Natural History (MNHN, France), the Institut de Recherche pour le Développement (IRD, France).

Collaborating organisations: Royal Belgian Institute of Natural Sciences (RBINS), the New Guinea Binatang Research Center (BRC), the University of Papua New Guinea (UPNG), and the Divine Word University of Madang .

Funding agencies: Prince Albert II of Monaco Foundation, the Stavros Niarchos Foundation, the Total Foundation, the Fondation d'entreprise EDF, the Fonds Pacifique, Spiecapag, Entrepose Contracting, the New-Caledonia Government, the Reef Foundation and the Belgian National Lottery.

Official website: http://laplaneterevisitee.org/fr

Webpages with more informations on the land module:

http://cb.naturalsciences.be/ants/ibisca-doc-pw/OPR-PNG.htm

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 **with the number of specimens from each (morpho-)species** as output, using the *identification list (Excel sheet available on the project webpages)*. This list is returned to the group coordinator and the PIs preferably within **1 year from receipt of the samples at latest**.
2. To respond every 6 months to an **inquiry** by the group coordinator and PIs with a simple state-of-the-art of my progress.
3. To return the samples to the group coordinator without delay if no progress has been made the agreed upon deadline, or - at any given moment - if I do not longer intend to study the samples.
4. To further study, identify/describe the specimens. Updates of the initial identification list are sent to the group coordinator and PIs as the investigations proceed.
5. To provide a pdf file to the group coordinator and PIs 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 – Papua New Guinea 2012", host organisations / counterparts in the host country and funding agencies in the "Acknowledgements" section of those scientific papers (see the project webpages for more details).
6. A standard label provided by the PIs is added to each specimen or sample (see 7).
7. To return the holotype and/or the number of paratypes, or the number of specimens, as indicated in the return/retainment table to the Taxonomic Group coordinator mentioned above and who is in charge of depositing the material according to the return/retainment table (see p. 2 of this agreement). This is done within six months after the publication of the corresponding scientific paper or the identification of the specimens, and 2 years from receipt of the samples at latest. Mention the final depository of the specimens in your papers.

Date:

[write: "read and approved", and sign]

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

Our Planet Reviewed – Papua New Guinea Expedition, 2012

Principal Investigators (PIs): Maurice Leponce (Maurice.Leponce@naturalsciences.be) and Vojtech Novotny (novotny@entu.cas.cz)

Lead organisations: Pro-Natura International, the National Museum of Natural History (MNHN, France), the Institut de Recherche pour le Développement (IRD, France).

Collaborating organisations: Royal Belgian Institute of Natural Sciences (RBINS), the New Guinea Binatang Research Center (BRC), the University of Papua New Guinea (UPNG), and the Divine Word University of Madang .

Funding agencies: Prince Albert II of Monaco Foundation, the Stavros Niarchos Foundation, the Total Foundation, the Fondation d'entreprise EDF, the Fonds Pacifique, Spiecapag, Entrepose Contracting, the New-Caledonia Government, the Reef Foundation and the Belgian National Lottery.

Official website: http://laplanetevisitee.org/fr

Webpages with more informations on the land module:

http://cb.naturalsciences.be/ants/ibisca-doc-pw/OPR-PNG.htm (username: *ibis*, password: *canopy*)

Return/retainment table

New species

new species					
no specimens	MNHN & PNG[1]	Retained by the expert	ANIC[1]	British Museum[1]	Bishop Museum[1]
1	HT[1]	-	-	-	-
2	HT + 1 PT[2]	-	-	-	-
3	HT + 1 PT[2]	1 PT	-	-	-
4	HT + 2 PT[2]	1 PT	-	-	-
5	HT + 2 PT[2]	2 PT	-	-	-
6	HT + 3 PT[2]	2 PT	-	-	-
7	HT + 3 PT[2]	2 PT	1 PT	-	-
8	HT + 3 PT[2]	2 PT	1 PT	1 PT	-
9	HT + 3 PT[2]	2 PT	1 PT	1 PT	1 PT
10	HT + 3 PT[2]	3 PT	1 PT	1 PT	1 PT
> 10	HT + at least 50% PT	at most 50%	>1 PT	>1 PT	>1 PT

HT: holotype specimen ; PT: paratype specimens

[1] In accordance to the export permit #012297 delivered by the Department of Environment and Conservation. Holotypes are deposited by default at MNHNor alternatively to RBINS. Holotypes and paratypes must be sent to the Taxonomic Group coordinator who will further distribute the material.

[2] One of the paratype is reserved for return to Papua New Guinea, in accordance to export permit #012297.

Type and paratype material has to be returned mounted.

A representative sample of the species collected has to be returned to the MNHN. One specimen is reserved for return to Papua New Guinea. These specimens must be sent to the Taxonomic Group coordinator.

no specimens		
	MNHN & PNG	Retained by the expert
1	1	0
2	2	0
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 1 to 5 should preferably be mounted.

Labels to be added to each species sample

Sample code and vial code (according to the project standards, see the webpages). Collection method, site, GPS coordinates, collector, collection date, "Our Planet Reviewed – MNHN/PNI/IRD 2012".

Address of the Taxonomic Group coordinator for return of material :